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INSTITUTION RESEARCH MEETING

THE 13th Autumn Research Meeting of the Institution of Gas Engineers was held on Tuesday and Wednesday of last week at the Institution of Mechanical Engineers, London. The proceedings started at ten o'clock precisely on the Tuesday morning, with the President, Dr. Harold Hartley, in the Chair and obviously with determination to keep to schedule the business and discussions throughout four packed sessions. For the most part it was a meeting of experts for experts, though there were signs—rather belated, we suggest—that heed is being paid to the demand of the "ordinary" man in the Gas Industry that he is entitled to be told in reasonably simple language the nature of the researchers' work and to be informed to some extent of the conclusions drawn. For example, considering that people had come to the meeting from all over Great Britain, there was an air of unreality in the proceedings of the second session, and many may well have wondered whether, during a time of crisis, a one-day meeting might not have filled the bill adequately. We say this knowing that by now the Industry realizes the value of research, appreciates the necessity for it, and respects those engaged in it.

The President, Dr. Harold Hartley opens the 13th Autumn Research Meeting of the Institution of Gas Engineers.

The attendance was representative rather than large when the President, at two minutes past ten called upon Mr. G. C. Pearson, Chairman of the Chairmen's Technical Committee, to present that Committee's 8th Report—a statement of work over an exceedingly wide field running to 50 odd pages of Institution "blue book"—"a great testimony to the voluntary work done by members of committees and one more indication of the real service which can be rendered by the Institution in the affairs of the Industry." We quote Mr. F. M. Birks, the first speaker in the discussion. Much of the report is taken up by the results of experience in the gasification of oil in both horizontal and vertical retorts. To-day the former policy of increasing by every means the gasification of oil in order to save coal has been revised owing to improved outputs of coal and accelerated by the adverse dollar exchange. Culmination came with the withdrawal of the gas oil subsidy. The incentive now is to return to pre-war technique in gas-making, with water gas employed for meeting peak load demands. At the same time the experience gained from the gasification of oil has been most valuable and the record reflects great credit on all concerned.

We were very interested in Mr. Birks's comments on the inter-relationship between the gas and the coke oven industries. There are, in fact, he said—and we would underline this—two coke oven industries. One is for the manufacture of metallurgical coke, which naturally integrates with the steel industry. The other embraces the coke ovens operated by and for the Gas Industry. There can be no advantage to the community by linking coke ovens with the collieries.

Speaking of the work of the Gas-Works Safety Rules Committee, Mr. E. G. Stewart explained that during the past year this had followed closely the pattern of previous years. "On all our works," he remarked, "we have equipment, notably purifiers and gasholders, which are long lived and continue to operate at good efficiency. It is likely, however, that the original designs of such plant contemplated physical conditions in respect of pressure, temperature, corrosion, and so on, different from the conditions which the manufacturers of plant to-day are called upon to meet." Hence older plants may be subjected to stresses in excess of their load, such stresses leading ultimately to failure. Pertinently Mr. Stewart commented on the rising incidence of electrolytic corrosion. This, he said, is doubtless a sequel to the increasing use of electricity on gas-works and of increased electrification generally. Consequently an expert sub-committee has been set up to investigate the matter thoroughly. Mr. Stewart drew attention to the risk of accident in horizontal retort houses due to inadequate clearances between stoking machinery and the structure of the house. There have been accidents from this cause. The Gas-Works Safety Rules Committee put forward recommendations which should conduce to safe working. Mr. Stewart, talking in terms of 1948, said that it was hoped to publish information on the behaviour of waterless gasholders under war conditions, which "it is expected will show that this type of construction is much more safe when bombed or burnt than had been at one time supposed." This has already been indicated in the "JOURNAL."

The membership of the Chairmen's Technical Committee is, we were told, to be increased.

Pointed and sharp were the comments of Mr. J. T. Haynes on meters. He spoke of the immense amount of effort required to amend the specification for domestic meters by tightening-up the tolerances allowed in the 1936 Specification. What has this meant? Mr. Haynes answered this question by saying it was an "expensive business," and he paid tribute to the meter manufacturers. "In many cases the opportunity has been taken to improve the standard of construction of the meters and their performance . . . . The Industry is now better served in this respect than ever before."

Following the introduction by Mr. John Terrace (Chairman) of the 24th Report of the Gas Education Committee, Mr. C. H. Chester described the report as giving ample indication that the Committee is alive to the growing demands of the time, in pro-

viding a real qualification examination. As an integral part of the revised scheme for Associate Membership the Common Preliminary Examination of the Joint Engineering Examinations Board and Joint Section A of the Associate Membership examinations of the Institution of Civil and Electrical Engineers has been included. Agreement has been reached with the other institutions concerned and further proposals for the initiation of a Joint Section B examination with the Institution of Civil Engineers have been satisfactorily concluded. This will enable students who have qualified for corporate membership of the Institution to become qualified for corporate membership of other engineering institutions without a great deal of repetition or further study. As Mr. H. J. Escreet mentioned, in future the paper for Gas Engineering will be set and marked by examiners from the I.G.E. Students will primarily be studying engineering and will specialize in gas engineering only in the last section of the examination. "I think," said Mr. Escreet, "that in the past young men have hesitated to start studying gas engineering because they have felt that once in this profession they could not change to another, whereas a general engineering training would give them a wider choice of jobs should they wish to change at a later date. The new course should overcome this difficulty to some extent and should also enable the Gas Industry to recruit partially trained civil engineers who could qualify in gas engineering in the final stages of their training." Mr. Chester rightly pointed out that a larger number of highly qualified gas engineers and specialists will be required in a fully developed and integrated Gas Industry, as well as men who can think with their technical knowledge on policy matters. Regarding training in general Mr. Chester put forward the view that a student's five-year period should be split up into various parts. His first allocation should be the laboratory, followed by a stage in the workshops. Then, for a period of at least a year, he should be attached to a drawing office. Then there should be a period concentrating on the distribution side, and his training should finally be rounded-off by a junior appointment to a shift superintendent.

Mr. J. Hunter Rioch confined his comments to the Intensive Courses in Gas Engineering, in which he is particularly interested and in which he is a great believer. The standard achieved in these intensive courses, he remarked, is appreciably higher than that attained by students following a normal course of study—which highly satisfactory result is "surely in itself a comp'ete justification for the energy which is being expended on these courses by all concerned." This led to the suggestion that there should be instituted similar courses on a permanent basis. Intensive courses have one main disadvantage—that the time allowed is inadequate to cover satisfactorily the comprehensive syllabus. There is also an obvious advantage from the student's point of view in attending a full-time course. Another point is the great diversity of standard between candidates submitted for examination from different technical colleges. Again, students preparing for the examinations in the main subject by evening study at technical colleges, or by correspondence courses, have no uniform practical work in their subject. The intensive courses have proved their worth. The next step should be to establish residential courses on a regional basis as a permanency in the Institution's educational programme; and as a corollary there should be an adequate number of well-qualified tutors. "The standard of the new Associate Membership examination will be higher than has hitherto been accepted," concluded Mr. Rioch, "and this in itself is a further justification for my plea to establish regional centres giving full-time instruction."

Presentation of Diplomas

The President presented Diplomas in Gas Engineering (Manufacture) for 1947, to: F. Grosett (Birmingham), 1st Class; A. W. Sanders (Birmingham), 1st Class; T. W. Benstead (Clacton-on-Sea), 2nd Class; T. H. Canning (Bromley-by-Bow, London), 2nd Class; P. E. Gallaher (Birmingham), 2nd Class; R. Kinsey (Salford), 2nd Class; T. B. Livingstone (Perth), 2nd Class; G. Shortland (Sunderland), 2nd Class; K. J. Sweeting (Farnham), 2nd Class; J. A. Taylor (Warrington), 2nd Class. A Diploma in Gas Engineering (Supply) for 1947 was presented to: G. Croad (Sowerby Bridge), 2nd Class.

Dr. Hartley then came to the presentation of the Charles Hunt Memorial Medal. Mr. Holmes Hunt was present at the meeting, and he handed the award to A. W. Sanders.

Dr. Hartley presented the James Archibald Maclay Memorial Prizes for 1947 to R. B. J. Smith (Bath) and D. W. Cattlin (Tonbridge). This is a new award. Mr. Maclay was born in 186[illegible] and joined the firm of R. & A. Main, Ltd., in Glasgow at the beginning of 1885, subsequently becoming the Senior Representative. In 1920 he was elected to the Board of Glover & Main and its allied companies, and in 1928 was appointed Sales Director to Thomas Glover & Co., and R. & A. Main. He devoted his life to the sales side of the business, and his activities were well known not only in the United Kingdom, but in Europe and South America. His knowledge of the various sides of the Industry was invaluable to his business associates and especially to junior members of the Industry, to whom he was always ready and willing to offer advice and help, and in whose training and development he exercised keen interest. Mr. Maclay died in February, 1946.

District Heating

The final item of the Tuesday morning's session was the presentation and discussion of the 2nd Report of the District Heating Committee. The report and discussion are published in full in our issue to-day.

Aerated Burner Flames

First item on resumption of the meeting on the Tuesday afternoon was the presentation and discussion of the Institution Gas Research Fellowship Report for 1946-47, "Recent Studies in Aerated Burner Flames," by G. W. Culshaw (Institution Gas Research Fellow) and Dr. J. E. Garside (Lecturer in Fuel Technology at the University of Leeds). During the past few years a considerable number of publications have appeared dealing with one aspect or another of the subject of aerated burner flames. In this Fellowship Report information contained in these papers are brought to the notice of the Gas Industry. The papers have originated chiefly in the United States of America, Germany, France, and Holland. Some of the investigations had been carried out either entirely or in part as war projects, their publication having been withheld pending the cessation of hostilities. Here the latest information is collated and critically discussed; this has especial value since the several authors have advanced varying explanations of identical occurrences. An attempt has been made at correlation and attention has been drawn to the various points of disagreement, while important problems still awaiting solution are indicated. One fundamental difference between the various workers is how far variable conditions of temperature, pressure, mixture composition, or turbulence, may conduce to a variation of ignition velocity over the surface of the inner cone of an aerated flame. Any such variation might be expected to produce a dependence upon burner diameter of the ignition velocity of any one mixture and this has been indicated in some of the investigations under review. Lewis and von Elbe have, by a beautiful technique, determined the ignition velocity at many points over the surface of the inner cone and have indicated that it falls from very high values at the apex, through a constant range, to zero at the lower peripheral zone of the flame.

Almost every study of the ignition velocity of gas-air or gas-oxygen mixtures up to 1941 had been concerned with laminar gas flow only. Many industrial and some domestic burners, however, operate at Reynolds Numbers above 2,000, when the gas flow is turbulent. The ignition velocity of combustible gas-air mixtures in the turbulent state has recently been studied by German and French workers, and the results show that there is a considerable increase in this parameter, particularly when the Reynolds Number is increased from 2,000 to 3,000. The subject of turbulent flames is difficult experimentally, but the difficulties have been overcome and an attempt has been made also to study the subject mathematically.

The thickness of the inner cone of an aerated flame, which has been studied under conditions of both streamline and turbulent flow, by various investigators, may have an important bearing upon the general study of reaction kinetics of flames. Measurements had been made of this thickness by J. S. Forsyth, a former Institution Research Fellow, in the case of several carbon monoxide-air mixtures, and the results are now included in this report. Again, the back pressure exerted by the inner cones of aerated flames has hitherto received little attention, but recently measurements of the property have been made and theoretical deductions drawn by more than one investigator. Finally, the phenomenon of dead space has been further investigated both here and abroad, and there are included some recent

The platform on the first day of the meeting.

results dealing with its variation with burner diameter; and a hypothesis is advanced of a relationship between dead space and the limiting pressure below which combustion cannot occur.

Arthur Duckham Fellowship Report

There followed the Third Arthur Duckham Fellowship Report, 1946-47—on "Energy Transfer from Flame Gases to Solids." Dr. J. K. Kilham, Research Fellow, recalled that the purpose of the investigation was to elucidate the problem of the mechanism of energy transfer from flame gases to solids immersed therein. In the report for 1945-46 it was considered probable that the energy may be transferred by any or all of the following processes:—(1) Forced convection from the hot flame gases to the solid; (2) catalytic combination of free radicals or atoms in the flame gases, on the surface of the solid; (3) catalytic combustion on the surface of the solid; (4) transference of excess energy by collision of high-energy gas molecules and the solid; (5) exothermic displacement of equilibria—*e.g.*, the water gas equilibrium.

Consideration of these possible mechanisms led to the conclusion that, in general, the bulk of the energy transfer is by forced convection, and a method of determining the rate of energy transfer from a flame to a refractory tube was devised. Preliminary results only could be obtained, however, since a suitable thermopile was not available at that time. In the course of the past 12 months a thermopile has been procured and calibrated, thus enabling quantitative data to be obtained for the rates of energy transfer. The results seem to confirm the theory that forced convection accounts for most of the energy transfer in the case of a freely radiating solid in a flame. It is fully realized that this is a special case only, but one which is closely connected with ordinary gas fires. The limiting factor in this case is the emissivity of the solid, since even if the latter could receive energy from the flame by mechanisms other than forced convection, it must still lose this energy by radiation, and the only way in which the loss could be accomplished is by an increase in temperature, which in turn would decrease immediately the energy transfer by forced convection.

It may be that, in other cases (*e.g.*, furnaces and boilers, where heat is being removed from the solid by conduction), alternative mechanisms might be involved. The investigation of such cases necessitates the development of a different experimental technique, and has not been attempted as yet.

Pinhole Gas Burners

Then came a paper on "Factors in the Design of Pinhole Gas Burners," by Dr. R. Jessell and H. R. Hindley, of Ascot Gas Water Heaters, Ltd. We shall consider this contribution more fully in the "JOURNAL" in a subsequent issue. We may mention here that the properties of the flames which have been considered by the authors are their height, the amount of heat radiated, and the speed with which the flame will run along the tube, jumping from port to port, after the burner has been lit by a pilot flame at the first port. These are the properties which interest the designer of gas appliances, inasmuch as the flame height affects the overall size of the appliance, the radiation has a bearing on the dimensions of the combustion chamber and also on the overall efficiency, as part of the radiation is always lost, and the speed of the flame along the tube decides whether the ignition shall be quiet or not.

The factors which affect these flame properties are the port diameter, the spacing of the ports along the tube, the tube diameter and shape, the gas rate, the air supply, and the gas quality. This paper shows the effect of all except the last of these variables.

The object of the work has been to accumulate data useful to the designers of pinhole gas burners. Usually, any such design must be a compromise between the several factors involved. By achieving a fuller understanding of the relationships between these factors much trial-and-error work may be obviated.

Burner Design

Finally, we had a paper by L. T. Minchin entitled "Current Problems in Burner Design and Flame Behaviour." An introduction to this paper remarks that the bunsen burner has been the object of a great deal of careful study during recent years. A surprising amount of research work was done during the war years, though it must often have happened that a scientist was unaware of similar work being done by a counterpart in some other, perhaps enemy, country. Here again this paper correlates some of these researches and, at the same time, draws attention to some small items of original work which by themselves would have been hardly sufficient to justify a separate contribution.

The author made no apology for adding to the many papers on the subject to the Institution a further one, for "the gas burner is an apparatus of such prodigious commercial importance that the value of a proper theoretical understanding of it can hardly be over-emphasized. Moreover, in spite of the apparent simplicity of the contrivance, there are still some disconcerting gaps in our understanding of the phenomena associated with it." It is the author's hope that his brief survey of some of these gaps may lead to further investigations which will help to consolidate burner theory and this, in turn, lead to advances in practice.

Work of the Gas Research Board

The second day of the meeting was devoted to discussion on the work of the Gas Research Board and was prefaced by a statement by Dr. H. Hollings, Chairman of the Board, who presided during the two sessions. Dr. Hollings explained that the work of the Board is now in process of considerable expansion. He went on: "So that the Council may devote more of its time to the management of the Board's affairs and to the periodical review of the research programme on broad lines we have set up several small panels of experts to advise upon the conduct of specific researches remitted to them by the Council. The work on the gasification of coal under pressure is proceeding at Bournemouth. The original pressure vessel was designed for a study of the hydrogenation of coal. On the advice of the panel which has this work under review the Council is now considering

the practicability of obtaining a new pressure vessel designed primarily for a study of the behaviour of various bituminous coals when gasified under different pressures of steam and air. An order has been placed for a small water gas generator specially designed for operation with a preheated air blast. The trials to be made as soon as this plant is available should indicate the practicability or otherwise of obtaining higher thermal efficiencies which several calculations in recent years have shown to be possible in water gas manufacture. It is probable that within a few months the programme of work on methane synthesis will have reached a stage at which we can present a final report. The large scale trials of catalysts at Bournemouth are proceeding very satisfactorily and if we can suspend this work pending some industrial development of the process we can release staff for other work.

"Last April we indicated that we were starting a new work on the size distribution of coke with particular reference to a study of the works screening and cutting processes. This is proceeding more slowly than I could have wished because of delays in securing the necessary apparatus, but the staff has been fully engaged on other work relating to the ash content of coal and coke. This has involved the isolation of retorts for the carbonization of special consignments of coal.

"The new programme concerned with the removal of hydrogen sulphide from gas has made a promising start, and the Council has decided that the questions relating to wind stresses in spirally-guided gasholders should be explored further. Although no major experimental programme has been authorized as yet, it is hoped, with the assistance of the appropriate panel, to plan a series of observations on a full size holder which should assist designers. This is the kind of investigation in which it is important to enlist the help of experts before any fresh work is started.

Dr. H. Hollings, Chairman of the Gas Research Board, took the chair during the proceedings on the second day of the meeting.

"The health of any research organization," continued Dr. Hollings, "depends ultimately on the maintenance of an up-to-date scientific outlook, but there are certain dangers in setting an industrial research organization to work on what are sometimes called the fundamental problems unless the research team has adequate knowledge of the practical requirements in industry. The practical investigations upon which we are now engaged are calculated, in my view, to provide just that factual knowledge necessary to enable the Council and the staff of the Board to define much more clearly what should be the longer term research projects."

The Financial Position

Dr. Hollings then referred to the financial position. "When commenting on the financial statement for 1946 we pointed out that our income had continued to exceed our expenditure. Our activities have now expanded to such an extent that we are no longer in this fortunate position. Furthermore, some of the accumulated surplus income has now been spent on the purchase of the headquarters site. I should perhaps remind you, too, that on Dec. 31 next we reach the end of the five-year period in respect of which the terms of the grant from the Department of Scientific and Industrial Research were settled. We have made application for a new grant and have been negotiating with the Department. While I am not yet able to tell you what the terms of the grant will be, it has been made clear to us that the payment of any grant at all will be dependent on increased payments by the Industry and, further, that the first block of the grant will be on a less generous scale than that of the total grant now being received. Accordingly we are faced at the moment with a rising expenditure and a falling income, although the new formula governing the grant is likely to be such that we may expect to receive considerably increased payments provided the Industry is prepared also to increase its contributions substantially. At a very early date we shall have to ask the Industry for a substantially increased contribution."

Finally, Dr. Hollings spoke of the headquarters of the Board. Purchase of the site at Beckenham has been completed and it appears that before the 1948 meeting vacant possession of the existing building will have been gained. After certain essential repairs this will house the Director and a part of the research staff, together with the Intelligence and clerical staffs.

Organic Sulphur Compounds

This brought us to the final report on a survey of the distribution of organic sulphur compounds in town gas—the 51st Report of the Joint Research Committee of the Gas Research Board and the University of Leeds. During the period February, 1944, to August, 1947, a survey has been made of the variation in the proportion of organic sulphur compounds in town gas which is brought about by the nature of the coal carbonized or by differences in the gas-making plant used, or by other minor variables. The purpose of the survey has been to provide a background of statistical information for the assistance of the gas engineer in the general problem of the purification of town gas to a low level of sulphur content. To cover the variables concerned, it has been necessary to make observations in 14 works in the British Gas Industry, and to make 250 sets of sulphur determinations on some 40 different streams of gas.

The following are the variables which have been examined:—Horizontal retorts, coke ovens, intermittent vertical chambers, continuous vertical retorts of a variety of designs by two leading firms, covering upward, downward, and lambent heating; blue and carburetted water gas plants, Trefois producers, and ordinary gas-works producers; gas-making coals from the Yorkshire, Durham, Lancashire, Nottinghamshire, and Derbyshire, Staffordshire, and Scottish coalfields. Calorific values from those of producer gas and blue water gas up to the 600 B.Th.U. per cu. ft. of straight coal gas and rich carburetted water gas. Then, in regard to benzole extraction admixture of various component streams to give the mixture sent out as town gas.

The variation of total organic sulphur content of the gas made at any one works may vary over a wide range (15 to 50 gr. S) and within relatively short periods of time. Such large variations would have to be allowed for in planning a plant for the removal of organic sulphur compounds. The fluctuation is caused mainly by variations in the sulphur content of the coals gasified. The fact that so great a fluctuation is not observed in long-term average values throughout the country is no doubt due to the common practice of carbonizing a fairly wide variety of coals at most gas-works. The average values for total organic sulphur in horizontal retort gas vary between 30 and 35 gr. S before benzole extraction, and show little variation from one works to another. The effect of type of coal or its sulphur content is obscured by rapid changes of the coal supplied, but in special cases, where coal of low sulphur content is supplied for long periods (one Nottinghamshire and several Scottish coals), the gas contains less organic sulphur, down to 12 gr. S. In general, the average organic sulphur content of gas from coke ovens is lower by about 10 gr. S than horizontal retort gas from the same coals, while the value for gas from intermittent vertical chambers lies between the two.

Vertical Retort Gas

In the case of gas from continuous vertical retorts, the organic sulphur content is on the whole slightly lower than that for horizontal retort gas, but not markedly so, averaging 30 gr. S. The difference can mainly be accounted for by dilution in the larger volume of gas made per ton of coal. The actual type of vertical retort is not a significant factor, nor is the method of heating. The effect of type of coal and sulphur content of coal is the same as for horizontal retort practice; a wide short-term variation may occur, and low-sulphur coals give organic sulphur values down to 12 gr. S.

The sulphur content of carburetted water gas appears to be somewhat less than half that of coal gas. The use of car-

buretted water gas can, therefore, be responsible for a drop in the average organic sulphur content of town gas. Observations made upon the generator of a carburetted water gas plant showed a negligible difference in total organic sulphur content between blue and carburetted water gases, while the back-run gas contained about 30% more organic sulphur than the up-run gas.

Producer gas has been examined as a recognized diluent for town gas. Its organic sulphur is mainly in the form of carbon oxysulphide; thiophen is absent. The total organic sulphur is about one-half that of average town gas, on a volume basis (*i.e.*, 15 gr. S), but about double on a thermal basis.

If a sulphur content of 10 gr. per 100 cu. ft. or some lower value, is to be aimed at for town gas, an organic-sulphur-removal process will have to be adopted widely in the Industry. Whether this shall be a one-stage or a two-stage process will be determined by the nature as well as the amount of sulphur compounds present. It is not impossible that methods may be developed which would be more efficient than those now available, but at the moment the relative merits of oil washing, or active-carbon adsorption, or catalytic treatment, or a combination of these, have to be considered.

The organic sulphur compounds have been classified, for the purposes of the survey as (i) thiophen, (ii) carbon disulphide, and (iii) "more volatile" sulphur compounds. The amounts of thiophen in town gas vary markedly with the nature of the gas-making system from rarely more than 5 gr. S in vertical retort gas, to 5 to 10 gr. S in horizontal retort, coke oven, and intermittent vertical chamber gases. There is some evidence that thiophen content is increased in gases from static retorts by increase of the free space above the charge. Carburetted water gas contains only 2.5 gr. S as thiophen, all of which is derived from the oil. This thiophen can effectively be removed by scrubbing with oil or active carbon, as in benzole recovery, down to 0.5 gr. S, when operating for partial recovery of benzole this value may rise to 1.5 gr. S. Up to the present, a satisfactory process for the catalytic removal of thiophen has not been found. If, therefore, the organic sulphur content of coal gas is to be reduced to less than 5 to 10 gr. S, it will be necessary to employ oil or carbon scrubbing as well as catalysis, unless a means can be found for the catalytic breakdown of thiophen.

The proportion of carbon disulphide in town gas has been found to increase with increase of the total organic sulphur content of the gas; at 25 gr. S total it is about half, while at 40 gr. S total it is more than 60%. This conclusion is independent of the type of retort or of the coal carbonized. Carbon disulphide can be eliminated almost completely by catalytic treatment of the gas; in normal treatment for the complete recovery of benzole, only about one-third is removed. Finally, the "more volatile" organic sulphur compounds, which consist mainly of carbon oxysulphide, vary in amount from 3 to more than 10 gr. S, depending upon the nature of the gas-making system. It is lowest in horizontal retort gas and coke oven gas (3 to 5 gr. S), higher in continuous vertical retort gas (5 to 10 gr. S), and highest in carburetted water gas (10 to 12 gr. S). It is concluded that the presence of steam favours the formation of carbon oxysulphide at the expense of carbon disulphide. Owing to the high vapour pressure of the volatile sulphur compounds, they are not reduced in amount by benzole recovery. They are, however, readily amenable to reduction by catalysis.

It is a common practice to remove benzole from gas before distribution as town gas. The amount of sulphur remaining after benzole extraction will depend naturally upon the process adopted, the thoroughness of the benzole removal, and the nature and quantity of the sulphur compounds present, since these are not equally affected by the processes used for benzole recovery. At three works employing normal oil washing processes and recovering rather more than 3 gall. of crude benzole per ton of coal, it was found that about one-third of the organic sulphur compounds was being removed. The reduction was mainly of the carbon disulphide and thiophen, the carbon oxysulphide being only slightly affected. At one works visited, where active carbon adsorption was in use, the removal of sulphur was more complete (about two-thirds) when the carbon was new, but the average efficiency of removal over its useful life was not greatly superior to that of oil washing. At present the average organic sulphur content of town gas appears to lie between 20 and 25 gr. S, if one excepts gases obtained from low-sulphur coals. This average could be improved materially by a more general resumption of benzole washing.

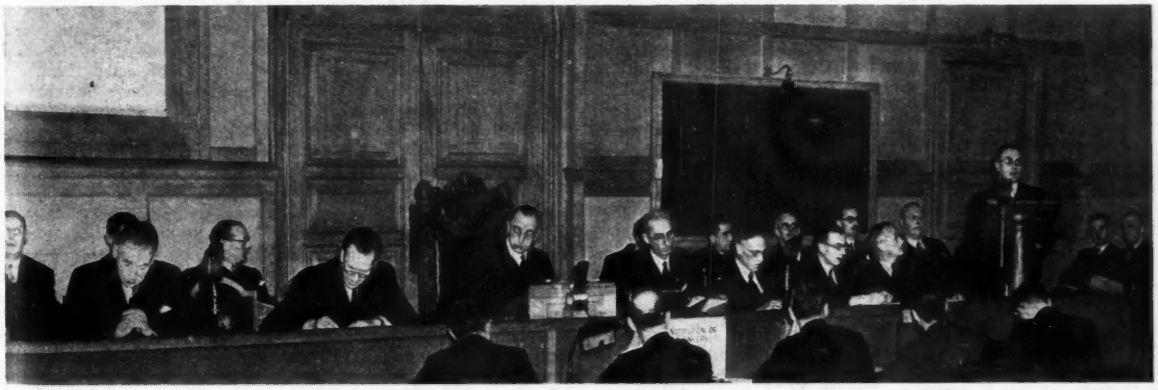
Refractory Materials

Wednesday morning's session was brought to a close by the 38th Report of the Refractory Materials Committee. This includes an examination—to which we shall refer more fully in a subsequent issue of the "GAS JOURNAL"—of the brickwork of 13 continuous vertical retorts let down for repair or reconstruction. The zonal character of the deterioration of vertical retorts has been recognized for some time. It was emphasized in the digest of replies to the questionnaire on the durability of refractory materials in gas-works, given in the 25th Report in 1934. The more recent observations have amply confirmed the earlier findings. Of the various types of deterioration noted, the following are regarded as the most important in affecting the life of the retort:—(*a*) disintegration of the firebrick at the top of the retort, (*b*) flaking of the carbonizing surface 6 to 12 ft. from the top of the retort, and (*c*) slag action at the bottom of the retort.

In regard to (*a*) it is pointed out in the report that the temperature of the surface of brickwork in this portion of a retort may fluctuate considerably consequent upon uneven travel of the charge. The range of fluctuation embraces 573°C., the temperature of the α-β quartz inversion, at which there is a 3% volume change. Observations have shown that the quartz grains in the firebricks in this zone are frequently badly shattered. In regard to flaking, no evidence of its dependence on alkali or other chemical action has been obtained for lime-bonded silica bricks. As a working hypothesis, it is suggested that the main cause of flaking in silica material is the difference in thermal expansion of the silica and the scurf which is closely bonded to it. This is quite marked in the range 700° to 1,000°C., so that severe stresses may be set up by temperature variations. The slags developed towards the bottom of the retort were observed to be generally more viscous when formed on the siliceous refractory than on the silica material. Thus the siliceous slags tended to remain on the surface, while the slags formed on the lime-bonded silica were more frequently absorbed into the pores of the refractory. This observation may also be of significance in regard to flaking.

Combustion Characteristics

Another final report—the 52nd of the Joint Research Committee of the Gas Research Board and the University of Leeds—was the



Mr. J. E. Davis speaking during the meeting on the second day.

first item on the resumption of the meeting on the Wednesday afternoon. Concurrently with the investigation described in the 51st Report, a survey was made of the variation of the chemical and physical properties and combustion characteristics of town gas which are brought about by the nature of the coal carbonized, or differences in the gas-making plant used, and by other variables such as dilution with carburetted water gas, producer gas, or waste gases. The purpose of the survey has been to provide a background of statistical information in the consideration of the general problem of the utilization of town gas, and to indicate the direction in which research work should be developed on problems associated with the efficient combustion and utilization of gas. An essential part of the survey has been the examination of component gas streams and of mixtures of them, often outside the proportions normally distributed by the undertakings, so that in all data for some 50 streams of gas have been obtained, at 14 representative gas-works, ranging in calorific value from 125 B.Th.U. per cu. ft. for producer gas to 625 B.Th.U. per cu. ft. for straight coal gas and highly carburetted water gas. At the first seven works the separate gas-making units were each operated to produce gas of the declared calorific value of the undertaking; at the other seven works each unit was operated to the best advantage and the declared calorific value obtained by mixing gas streams often of considerably different calorific values, and in some cases by adjusting the amount and calorific value of added carburetted water gas.

The procedure has been to make systematic observations of the calorific value, specific gravity, and A.T.B. Number of the town gas, and of the gas streams from various units of plant at each works. If consideration is confined to current carbonizing methods and to the normal gas-making coals from the various coalfields of this country, the nature of the coal does not appear to be a major factor in determining the combustion characteristics of the gas produced. The main factors which do determine combustion characteristics would appear to be the choice of declared calorific value and the type of diluent employed for adjusting the calorific value of the straight carbonization gas. It is immaterial whether the diluent used is produced *in situ*, as in continuous vertical retorts, or is added from an external source as in the case of producer gas or waste gases.

The combustion characteristics of carburetted water gas are very different from those of coal gas of equal calorific value, and variations in the proportion of carburetted water gas employed may therefore cause noticeable differences in the behaviour of town gas, the effect of such addition being to "harden" the flames of gas appliances fitted with aerated burners.

Under comparable conditions of supply (*i.e.*, for equal calorific value and pressure), the specific gravity of town gas determines the thermal delivery of appliances, and, in the case of aerated burners, the degree of primary aeration. More careful control of specific gravity would considerably improve gas service, without, however, in all cases guaranteeing uniformity of performance. At the present time some undertakings are maintaining the specific gravity of their town gas within ± 10% of its mean value, but control within closer limits would be accompanied by considerable technical difficulty. The combined effect of variation in both calorific value and specific gravity is expressed by the Wobbe Index of thermal delivery, which might receive consideration as an alternative to specifying calorific value and specific gravity separately.

It is concluded that: (i) The control of calorific value alone, no matter how exact, is of itself insufficient to ensure uniformity of combustion characteristics; (ii) the various diluents used have different effects upon the properties of the resultant mixture, and it is therefore important at any one works to adopt a uniform scheme for attaining the declared calorific value; (iii) if all the component streams are varying in quality, the use of an instrument such as the Aeration Test Burner could be of considerable assistance in maintaining uniformity of combustion characteristics; (iv) in the range of medium calorific values, it is possible to do a good deal towards correcting any undesirable effects of addition of carburetted water gas by adjusting the calorific values of both the coal gas and water gas, instead of making each at the declared calorific value, but the effective use of this method implies the provision of holder capacity for mixing and storage.

To a first approximation and within such limits as are of importance in practice, the A.T.B. Number of a mixture is the weighted mean of those of its component gas streams. In the case of carburetted water gas mixtures the A.T.B. Number of the mixture is somewhat nearer to that of the carburetted water gas component than the above rule would indicate. Within the range of calorific values of town gas examined, benzole removal, which would be expected to reduce the A.T.B. Number, does not have that effect upon the final gas, since the reduction is neutralized by the smaller amount of diluent permissible with the debenzolized gas.

The increasing use of non-aerated burners has made it necessary to include in the survey observations with this type of burner. Two of these were used, a rat-tail burner with a circular orifice 0.75 mm. dia., and a flat-flame burner, actually a Bray No. 2 geyser burner. With the first the overall height of the flame and of its luminous tip were measured at pressures up to 6.0 in. W.G., the latter being by far the more definite for purposes of measurement. The results obtained with non-aerated burners show that with any one kind of gas the height of the luminous tip is proportional to the gas rate, but a quantitative statement with regard to gases in general is not yet possible. The height of the luminous tip is certainly not proportional to the calorific value, specific gravity, Wobbe Index, gas rate, or hydrocarbon content of the gas. Up to an A.T.B. Number of 50, very rough proportionality between the height of the luminous tip and the A.T.B. Number of the gases has been established (*i.e.*, 1 cm. for each five A.T.B. units). There are, however, divergencies of 25% to 30%, the height of the luminous tip with carburetted water gas being much in excess of that with coal gas of equal A.T.B. Number. The removal of benzole from the coal gas causes a systematic lowering of the height of the luminous tip for a given A.T.B. Number. The principal observation with the flat-flame burner has been the pressure at which the flame becomes noisy and distorts or "flares." For the burner used this seems to range between 2.0 and 3.5 in. W.G., but the results are quite erratic and it has not proved possible as yet to connect flare pressure with any other property of the gas.

The report concludes by saying that it is clear that the Aeration Test Burner is not a guide to the behaviour of gases in the non-aerated type of burner, and specific tests with non-aerated burners must be regularly made where this type of burner is extensively employed. The main variables with the non-aerated burner are flame-size and liability to soot formation, and more work on this type of burner is necessary before a useful statement can be made.

Production and Measurement of Convected Heat

Two further papers remained to be discussed, the first being by Mr. A. R. Bennett, Research Manager of Radiation Ltd., on "Some Recent Developments in the Production and Measurement of Convected Heat for Domestic Purposes." In this the Author points out that the economic aspects of convected heat have received much attention during the past few years, but this has not always been related to the ultimate objective of heating practice. Many people have set out to solve heating problems, without any clear realization of their objective. An answer in terms of equivalent temperature of a heated environment is only half the story. The sole aim of any domestic heating process is to secure the maximum degree of comfort for the occupants of a room, and this can be defined only in terms of physiological and psychological considerations. The most economical system is not, therefore, necessarily acceptable in terms of ultimate objective.

Despite all the investigations which have been carried out in this country and abroad on the basic requirements for house heating, the situation remains that we are still without comprehensive data on the relative merits of alternative systems. In the present state of knowledge, the basis of the case for convected heat is primarily economic, for under normal domestic conditions fuel can be burnt at a higher overall efficiency if the resulting heat is acceptable partly or wholly in convected form.

Comparisons of different heating systems have in the past been largely concerned with the economics of maintaining a given equivalent temperature rather than with the assignment of a figure of merit on the basis of the degree of comfort of the occupants of the space concerned. Efforts have been made from time to time to develop objective standards of comfort, but the inter-relation of the relevant factors (temperature of air and environment, air movement and humidity) is too complex to permit of reproduction by physical means. Consequently, we still have to rely ultimately on individual reactions in assessing the merits of a given heating situation, with the result that traditional practice and national or regional prejudices enter largely into our judgments. We must, however, continue our efforts to establish comfort standards on a factual basis and ensure that appliance development is directed with such standards in view.

The Author has devoted the greater part of his paper to tech-

nical details of the generation and measurement of convected heat, in the belief that this accords with the immediate needs of the Industry and of the nation as a whole. While, states Mr. Bennett, for traditional and other reasons the progress of domestic heating by convection has been retarded in Great Britain, there is little doubt that the use of gas for this type of heating has been further handicapped by the unsatisfactory design of some of the early convector appliances, which discharged products of combustion into the room in considerable amounts and presented heated surfaces on which dust could be deposited and charred. The effects of high chimney suction on the thermal output of these appliances were, also, frequently such as to result in a very low installed efficiency.

One striking fact about the subject of heat transfer by convection is that, despite the number and variety of the investigations on record, no generally applicable underlying theory has been developed; hence, results can be systematized only in terms of empirical formulæ of limited application. There are several directions in which the designer of convector heaters is hampered by this lack of a coherent, underlying body of knowledge. The direct measurement of convected heat output is necessarily a difficult experimental technique. Conditions of flow in natural convection are often unstable, and in any direct method of measurement the measuring apparatus is liable to introduce appreciable disturbances into the normal working conditions of the appliance under test. As the measurement of radiant-heat loss has been more fully developed, it is considered preferable to measure the radiant-heat output of an appliance together with the flue loss, and obtain the convected heat output by difference. A method of estimating flue loss with rapidity and accuracy has been developed in connexion with this work, and is described in the paper. The Author states that it has the advantage, over earlier methods, of eliminating the troublesome weighting and averaging of a multiplicity of readings, and reduces the determination to one of extreme simplicity.

Radiation from Gas Fires

The final paper was by P. W. R. Morpurgo and Dr. R. S. Silver on "The Measurement of Radiation from Gas Fires." In this communication the theory of sampling the radiation in the space in front of the fire is discussed and consideration is given to the effect of this sampling on measurement of the total radiation. An experimental investigation has been made of some of the errors which can occur in sampling. It was found that random errors in measurement of total radiation and of distribution factor did not exceed 0.3%. It was also proved that the 81 sampling position used in existing methods of testing are quite sufficient for the usual type of gas fire. The properties of some alternative sampling instruments have been examined: Moll thermopiles were found to be free from spatial distribution errors to which a Rubens thermopile was subject. The effect of the fluorite window normally fitted is discussed, and it is concluded that the calibration of the instrument should be made without the window, but that in routine testing it would be sufficient to determine transmission through the window at the central test-position only. Experimental results are also given showing the importance of the quality of the carbon black used on the thermopile, and methods of obtaining an improved black are described. A modified Moll thermopile has been constructed in which the aperture is defined by a knife-edge instead of the existing cylindrical hole. Experiments showed this to be a desirable improvement.

Possible methods of calibrating radiation sampling instruments are described and theoretical discussions are given of calibration by thermal balance and by radiometer. The latter method has been investigated experimentally. A water-flow radiometer was found to be unsatisfactory, and the existing procedure with a Richmond block radiometer was also found to be at fault, mainly because of errors introduced by the screen used to cover the block for determining the cooling correction. These errors were investigated, and as a result a modified block radiometer and shutter have been designed; it is anticipated that they should give a resultant calibration in which the mean of four determinations will be in error not more than 1%.

The spectral distributions from two typical gas fires have been examined; results for aerated and non-aerated fires were not appreciably different. It is concluded that an approximate "equivalent black-body temparature" could be determined from the spectral distribution.

Vote of Thanks

An omnibus vote of thanks was proposed by Mr. James Carr. To him, he said, the high lights of the two days' meeting had been district heating, the sulphur question, and refractories. These were immediate problems which they could certainly consider and study.

The vote was seconded by Mr. A. B. Britton, who remarked that they had listened during the two days to a condensation of an enormous amount of work done during the past 12 months, and while he was not going to try to assess—because he could not—the value of the work they had heard described in the various reports, some of it very highly scientific, many of them did not altogether appreciate the value of it to the Gas Industry until it was actually applied in appliances or plant. He called to mind the work of the Liquor Effluents and Ammonia Committee. When they had the reports presented to them they were of absorbing interest, but they did not altogether appreciate the monetary value of the information given, yet his own undertaking could not have carried on during the war without that work.

Personal

Mr. W. L. WRIGHT, who has had many years' experience of the Gas Industry in the Midlands, has been appointed Secretary of the Midland District Board of the British Gas Council, with a central office at King Edward House, New Street, Birmingham, 2. Telephone Midland 1186. Mr. Wright has also taken over the duties of Secretary of the Midland District of the Federation of Gas Employers, following the death of Mr. James Paterson.

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Mr. S. HALLIDAY, F.R.S.A., having resigned his position on the Sales Staff of the Portsmouth and Gosport Gas Company, has been appointed Technical Sales Representative on the staff of Parkinson & Cowan (Gas Meters), Ltd., of Terminal House, Grosvenor Gardens, London, S.W.1., in connexion with their infra-red paint drying and radiant heat equipment. Mr. Halliday, who prior to being commissioned in the R.N.V.R. in 1941 served on the distribution and sales staff of the East Surrey Gas Company, took up his position on Nov. 24.

* * *

Alderman J. B. GRIFFIN, who succeeded the late Sir Albert Ball at Chairman of the Nottingham Gas Committee, has relinquished the position in conformity with the Labour Party's decision that no alderman or councillor should hold the chairmanship of more than one committee. The Sheriff of Nottingham (Alderman W. SHARP) was elected to the chair, with Councillor W. E. MALTBY as Vice-Chairman. Alderman Sharp afterwards gave an assurance that there would be no increase in the price of gas in Nottingham at any rate for the present.

* * *

Fuel and power and finance continue to be strongly represented in the chief administrative offices of the Chartered Institute of Secretaries, which held its annual meeting at the Chartered Insurance Institute on Dec. 2. While a London practising chartered secretary (Mr. A. Gale Johnson) succeeds as President Mr. H. F. Carpenter (newly appointed Secretary of the British Electricity Authority), another fuel and power man, Mr. C. R. Heathcock, Managing Director of the Midland Electric Corporation for Power Distribution, Ltd., Birmingham, steps up to the Senior Vice-Presidency. Mr. M. E. Stapley, Chief Accountant for the Bank of England, becomes Junior Vice-President, and the new Treasurer is Mr. J. R. W. ALEXANDER, M.A., LL.B., General Manager of the British Gas Council.

* * *

Mr. K. L. PEARCE, who, as briefly announced in the "JOURNAL" last week, has been appointed Engineer and Manager of the Leicester Gas Department in succession to the late Mr. James Mitchell, commenced his career in the Gas Industry as an articled pupil to the late Mr. W. H. Adams, then Engineer, Manager, and Secretary of the Bilston Gas Light and Coke Company. On completion of his articles he was appointed Technical Assistant on the works staff, and on the death of Mr. Adams in 1932 he was appointed Assistant Engineer. In 1937 he became Deputy Engineer and Manager, and two years later he was appointed Engineer and Works Manager. Mr. H. S. Adams, who had been Engineer and Manager, left the services of the Company at the end of 1939, and Mr. Pearce then became Engineer and Manager. Since that time the works has undergone complete reconstruction and extensions and the output has grown from 400 million cu.ft. to 1,000 million. Mr. Pearce is Hon. Secretary and Treasurer of the Midland District Board of the British Gas Council and he also represents the District on the Central Board in London. He is a member of the Midland Management Committee of the Federation of Gas Employers and a representative of the employers' side on the Joint Industrial Council and the Appeals Sub-Committee of the Joint Industrial Council. He is a Past President of the Midland Junior Gas Association and of the Bilston Rotary Club.

Mr. RAYMOND WILSON, appointed Burnley's Deputy Gas Engineer in succession to Mr. T. D. Olver, now of Warrington, has served four years on the staff.

* * *

The recent sudden death of Mr. J. L. LOE, who had for many years represented E. Boydell & Co., Ltd., in North East England, took place only a few weeks before he was due to retire. Mr. Loe was well known in Yorkshire where he had a large business and social connexion. The Company announce that they have now appointed Mr. J. H. METTRICK to take over Mr. Loe's territory. Mr. Mettrick, who is a newcomer to the firm has, since his demobilization from the Army, been with a firm of mechanical handling engineers and is already well known among users of such equipment.

Obituary

The death occurred on Nov. 21 of Mr. ALBERT FIELD, Northern Representative of Cannon Iron Foundries, Ltd., Bilston; for many years. His loyal and devoted service to the firm was lifelong, extending to nearly half a century.

* * *

The death occurred on Nov. 23, after nearly seven weeks' illness, of Mr. T. H. GALBRAITH, Works Controller of the Radiation Group of Companies at Warrington. Mr. Galbraith, a native of Bolton, received his technical education at Bolton School of Technology and the Manchester College of Technology. In 1900 he began an apprenticeship in the fitting and erecting shops of John Musgrave & Sons, Bolton, and later worked for varying periods at Crossley Bros., Manchester, Austin Motor Co., Birmingham, Rolls-Royce, Derby, the Norton Motor Co., Birmingham, Lambourne & Co., Manchester, and the Mansfield Engineering Co., Nottingham. He joined Fletcher, Russell & Co., Ltd. as Works Manager in 1927, and continued in that capacity until 1940, when he was appointed to the position he held until the time of his death. During the war, apart from organizing the war effort in the factories under his control, he did good work as Chairman of the Warrington and St. Helens District Committee of the Ministry of Production. Since 1945 he has been in charge of the modernization of the Radiation Grappenhall Works by the introduction of a modern machine shop, continuous enamelling process plant and one of the finest continuous casting plants in the country.

Letter to the Editor

Governors and Governing

DEAR SIR,—I should like to express my appreciation of the excellent review by Mr. David Fulton, of Helmsburgh, in your issue Nov. 12 of Mr. B. R. Parkinson's book on "Governors and Governing."

The Author has given (most modestly having regard to his own particular inventions and his firm's work) a very full description, with simple diagrams, of the many designs of governors now available to gas engineers dealing with modern gas-works problems and distribution questions.

The greatly increased demands for gas can only be dealt with in two ways. First by largely increasing the size of mains, almost impossible in most towns, or secondly at lesser cost by increasing gas pressures by boosting and using governors of varying types to reduce such increases to usual individual pressure requirements. By means of governors pressure variations may be brought about with ease and safety.

It may be noted how much pressure loading has come to the front in various forms, and its application now is most impressive. My late father, Mr. D. Bruce Peebles, gave a valuable invention to the Industry in 1875, with a design of the first pressure loaded governor.

In Mr. Parkinson's book the formulae and tables are admirable and are a valuable feature, for nothing of the kind has been available in such simple form before.

I have retired from the active management of Peebles & Co., Ltd., after 56½ years, but as a Director am still very interested in all governor problems. I feel sure all gas engineers and students will appreciate the great value of Mr. Parkinson's work, which is a most excellent contribution to the present and future development of the Gas Industry.

Yours faithfully,

Edinburgh, Nov. 25, 1947. W. CARMICHAEL PEEBLES.

1947 "JOURNAL" DIRECTORY

In order to keep the Directory information up to date, the following alterations and corrections which have been notified during the past month should be noted in the 1947 issue of the "JOURNAL" Calendar and Directory:

Page 12.—Bilston.—K. L. Pearce, *E.* & *M.*, resigned.
,, 24.—Cowes.—C. B. Jones, *E.* & *M.*
,, 44.—Leicester.—K. L. Pearce, *E.* & *M.*, vice J. Mitchell, deceased.
,, 48.—Mablethorpe & Sutton.—F. Beaumont, *E.* & *M.*
,, 50.—Meltham.—F. Beaumont, *E. M.*, & *S.*, resigned.
,, 68.—Spalding.—R. C. Arnold, *Dep. E.*, vice H. E. S. Birks.
,, 78.—Warrington.—T. D. Olver, *E.* & *M.*, vice W. H. T. Johns, deceased.

News in Brief

The Coventry Works and Staff of George Wilson Gas Meters, Ltd., held their first combined outing since the war by taking a trip to London on Nov. 22, where many of the staff were able to do a considerable amount of their Christmas shopping. The party left Coventry at 8 o'clock and returned in the early hours of Sunday morning, after an extremely enjoyable day, many of the members of the party attending various theatres in London, also for the first time since the war.

Kirkintilloch Gas Department has started negotiations for the erection of a £23,000 extension to the existing plant which is working at total capacity. This new unit will be a Tully total gasification fully mechanically operated unit of one million cu.ft. per day capacity. Sanction has been received for borrowing and negotiations are now proceeding with a view to completion of the preliminaries. Actual construction, when finally approved, will depend very much on the availability of materials.

Goods Manufactured or Produced in the United Kingdom and returned here after being exported to sterling area countries have hitherto been allowed in without an import licence. The Board of Trade announce that this concession has been withdrawn with the exception of goods returned to the sender by parcel post from sterling area. Separate import licences are now required for all other imports of returned goods unless they are on the Open General Licence list. The application for import licence should give full details of the reasons why the goods have to be re-imported. Goods will, however, be admitted with import licence if the Commissioners of Customs and Excise are satisfied that they were despatched to the United Kingdom before Nov. 26, and re-imported before Dec. 17.

A Recommendation by the Gas Committee that the price of gas be raised by 5d. per 1,000 cu.ft. as from Dec. 1 was put to the vote at a meeting of the Kirkcudbright Town Council and resulted in an equal number of votes for the motion and for an amendment that the Committee had failed to present figures justifying this increase, nor had they warned the Council that they were looking forward to any serious expenditure in this connexion. Provost Kennedy gave his casting vote in favour of an amendment not to increase the price. It was stated that the increased price of coal was 6s. per ton, from which fell to be deducted additional receipts on coke at 7s. 6d., leaving a net increased cost to the Undertaking of £262 10s. Increased price of 5d. per 1,000 cu.ft. on a make of 16,000,000 cu.ft. would give a return of £336 6s. 6d. Increase of 5d. would make the price 5s. 10d. per 1,000 cu.ft. for industrial consumers, and 6s. 3d. for other cases.

Diary

Dec. 4.—London and Southern Junior Gas Association: Visit to Gothic Works of Glover and Main, Ltd., Edmonton, 10.30 a.m.
Dec. 4.—Solid Smokeless Fuels Federation: Executive Committee, 11.30 a.m.; Luncheon, 1 p.m.; Dorchester Hotel, Park Lane, W.1.
Dec. 4.—Wales and Monmouthshire Junior Gas Association. Paper by J. V. Drake, "Coke Oven Practice." Newport, 2.30 p.m.
Dec. 6.—Scottish Junior Gas Association: Joint Meeting of Eastern and Western Districts at Edinburgh. Paper by Mr. Joseph White, of Newcastle-upon-Tyne and Gateshead Gas Company.
Dec. 9.—National Federation of Gas Coke Associations: General Committee, Gas Industry House, 10 a.m.
Dec. 9.—British Gas Council: Central Board, Gas Industry House, 2.30 p.m.
Dec. 9.—Federation of Gas Employers: Central Committee, Gas Industry House, 11.30 a.m.
Dec. 10.—B.G.C. Gas Salesmen's Circle (Eastern District). Address, "Survey for Salesmen," R. J. Gregg, Ascot Gas Water Heaters, Ltd., Colchester, 2.30 p.m.
Dec. 10.—B.G.C. Domestic Development Committee; Gas Industry House, 2.30 p.m.
Dec. 11.—Domestic Development Committee: Technical Sub-Committee, Gas Industry House, 2.45 p.m.
Dec. 13.—Yorkshire Junior Gas Association: Meeting at Leeds. "Concerning Domestic Appliances," A. J. Winter (Leeds Gas Department).
Dec. 16.—Industrial Gas Development Committee, Gas Industry House, 2.30 p.m.
Dec. 16.—Midland Junior Gas Association: Meeting at Birmingham. "Electricity: its Use to the Gas Industry," J. C. Milne (Electric Construction Co., Ltd.).
Dec. 17.—London and Southen Junior Gas Association: Meeting at Gas Industry House, 7 p.m. "Street Lighting: Present Position and Future Prospects," L. T. Minchin, B.Sc., F.I.E.S.
Dec. 22.—London and Counties Coke Association: Finance Committee, 11 a.m.; Executive Committee, 11.30 a.m.; Central Committee, 1.30 p.m.

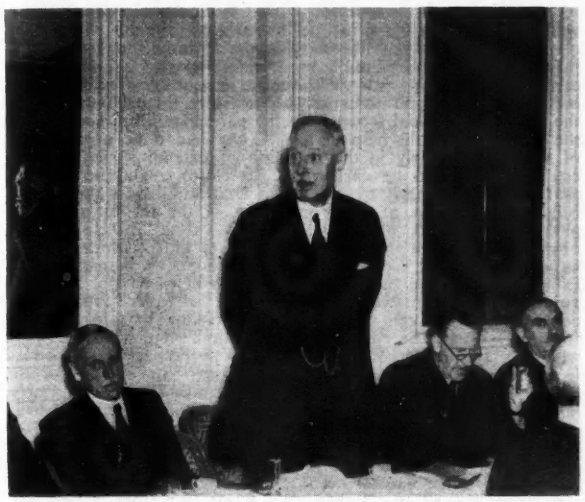
APPROACH OF GREAT EVENTS AND CHANGES

CO-OPERATION A KEY TO STABILITY

THE 13th Research Luncheon of the Institution of Gas Engineers was held at the Savoy Hotel, London, on Tuesday, Nov. 25. Dr. H. Hartley (President) was in the Chair.

Schools of Learning

The **President,** proposing the toast of "The Guests," expressed appreciation on behalf of the Institution at the presence of so many guests. They were particularly glad to have with them M. Comminges and M. Delbourg, both of the Research Department of Gaz de France, and both worthy representatives of their friends across the Channel. The Institution was honoured that they were present for it was an indication of the friendship which united the gas engineers of France and Great Britain—a friendship that was very acceptable in the difficult times through which both countries were passing.



Sir Roger Hetherington, C.B., O.B.E., President of the Institution of Civil Engineers, proposing "The Institution of Gas Engineers," referred to the new academic qualifications jointly agreed between the Civils and Gas.

Continuing, Dr. Hartley said it was just over 40 years since the members of the Institution forged a link with Leeds University, a link which had been strengthened in the intervening years. To date, there had been four occupants of the Livesey Chair, the late Professor Bone, Professor Cobb, Professor Townend, and now Professor Roberts. The Industry was fortunate in having had men of such different temperaments and outlook in that position and having the impact of their ideas on technical affairs. He was pleased that Dr. Townend was present, because in Bone and Townend they had had brilliant workers in the field of gaseous combustion, while the present state of their knowledge of carbonization and gasification owed much to the sound and often unspectacular work of Professor Cobb. While it was regretted at the time that Professor Townend decided to resign from the Chair, they were glad that he was the Director of the British Coal Utilisation Research Association. It seemed to him that in the future there would be a much closer co-operation between individuals concerned with the elucidation of fuel problems, and the better the workers in this fie'd knew one another the more readily would it be possible to knit together their activities. Professor Roberts had occupied the Chair for only six months, but he was well known to the Industry and they looked forward to a considerable extension of activities at Leeds under his guidance. There was much need for fundamental research in the field of combustion, such, for example, as the further investigation of the phenomena of detonation in the gaseous system. It was a personal hope that Professor Roberts would so extend the activities of that school of thought that in time he would become, as it were by adoption, a worthy member of the school of combustion research founded in Manchester in 1886 by the late Professor Dixon, whose mantle subsequently fell on the shoulders of W. A. Bone. Mention of the Manchester school, said the President, brought to his mind his old friend Sir Ernest Smith, for they had been personal friends for 45 years since the days when they were in Dixon's classes. Even in his student days at Manchester "E. W." had a penchant for organizing and tried his prentice hand on the affairs of the students. Those who knew his work were not at all surprised at the honour conferred on him by His Majesty the King, and the President said he was sure he was speaking for everybody when he said they wished Sir Ernest all success in the work he had undertaken as Chairman of the Industrial Coal Consumers Council.

Continuing, he said that the late Professor Bone left Leeds and undertook to develop at the Imperial College of Science a Department of Chemical Technology, and those interested in combustion began to talk of Bone and Townend and Bone and Newitt. It was pleasing to know that Professor Newitt was now at the Imperial College and was meeting with success in developing the school of Chemical Engineering there. The President welcomed, too, Viscount Falmouth, President of the Gas Research Board. They also had with them the Director of the National Physical Laboratory and the Presidents and representatives of kindred and learned bodies and research organizations, and of other bodies within and without the Gas Industry. There were also present the authors of the papers, and he assured them that the Council of the Institution was highly appreciative of the work and trouble they had taken in preparing these communications.

There were also present many eminent men in the Gas Industry, but he would only mention two. First, there was Sir Frederick West, a Past-President of the Institution and now President of the Society of British Gas Industries. Sir Frederick West had done so much for the Institution that its members would always remain under a debt to him, but his work for the Industry as a whole was of even greater importance, and last year he was awarded the Birmingham Medal, the highest award the Institution had to offer. Then there was Mr. Milne-Watson, who a short time ago was called upon to take charge of the Gas Light and Coke Company, the largest Gas Company in the world. Then there were two other guests whom he must mention. The first was Sir Roger Hetherington, President of the Institution of Civil Engineers, and the second Sir Charles Ellis, Scientific Member, National Coal Board, because of the part which he had been cast in connexion with fuel research. In the past, such research had, perhaps, been inadequately co-ordinated and there was also the suspicion of insufficient contact between fundamental workers in the Universities and research workers operating under the auspices of research associations and the technicians in industry.

A Clearing House Needed

It would be good if there was opportunity for these three classes to meet and discuss their problems, because the technicians in industry were concerned with their own special problems and perhaps were not altogether mindful of what was going on elsewhere. This had a bearing on the work of the Gas Research Board. Personally, he would like to see research co-ordinated in such a way as to leave authority and responsibility for everyday work in its own sphere to each of the three industries concerned. There was need for a clearing house for the examination of fundamental problems; there was need for them to see that more eminent scientists and brilliant young scientists should get to work on the problems of fuel utilization.

The Institution of Gas Engineers, concluded Dr. Hartley, had an appreciation of the part the technician had to play in the affairs of industry throughout the world, and it was their belief that the work of the technician, probably more than that of any other specialist, was essential to the development of industry. If that work was at fault, then progress would not be altogether satisfactory. Members of the Institution might originally have been trained as chemists or physicists, or engineers. They developed partly by the work which they did themselves, but they also had contact with one another by discussion of papers at such meetings as the Autumn Research meeting, and it was hoped that after nationalization nothing would happen that would interfere with such frank discussions.

Co-Ordinated Qualifications

Sir **Roger Hetherington** (President, Institution of Civil Engineers), responding to the toast, speaking as the titular head of one Institution to another, said there had been symptoms during the past year—which should be welcomed—of closer collaboration and friendly co-operation between the various Institutions which served the interests of the engineering professions in the various branches. That was a thing which would not only be welcomed but should be encouraged, and he personally hoped that it would grow in strength as time went on. It seemed to him that probably

the most effective way of bringing about joint working and friendly relations between Institutions was that there should be some co-ordination and co-operation in the standards of qualifications of the various Institutions. The best way of bringing that about was on the lines of the arrangement made between the Institution of Gas Engineers and the Institution of Civil Engineers with regard to the examination for corporate membership. The Institution of Civils divided its qualifying examination into three parts. Part A concerned the fundamentals of engineering, which it was thought every engineer should be able to pass in, and an arrangement had been made, which would come into operation in the near future, by which the two Institutions would share in that examination as far as Part A was concerned. That was a broad statement of the position. In regard to Section B, this referred to the technical qualifications of the candidate in the branch of engineering which he had adopted, and in this matter the Institution of Gas Engineers was going to help the Institution of Civil Engineers and take charge of Section B in so far as it related to gas engineering. Section C of the examination was what might be termed the private concern of the Institutions themselves. The Civil Engineers had their own views as to what a man should pass in Section C; gas engineers might have others, but there would in the future be a common bond in this entrance examination, and from that he hoped there would grow up a closer connexion between the two Institutions.

Professional Bodies under Nationalization

Sir **Charles Ellis, F.R.S.** (Scientific Member, National Coal Board), proposing "The Institution of Gas Engineers," said the Institution had a history extending back for 80 years, and it was the oldest of the national bodies in the Gas Industry. Some 18 years ago the Institution's high status and purpose was recognized by incorporation by Royal Charter. He would not refer in detail to the valuable work which the Institution had done because the members knew of that and could, indeed, be satisfied with its achievements, but he must express his admiration of such activities as the Education Scheme, and also the establishment of the Benevolent Fund. There was also the encouragement which had been given to research, and the endowment of post-graduate research Fellowships; and they would recall with pride the formation of the Gas Research Board.

Continuing, he said the President had referred to the early days of 40 years ago at Manchester, and he might well contrast the wonderful period of research activity under people like Dixon, Bone and Perkin, with what was happening to-day, and he could feel proud that he was worthy of his teachers and had produced something which would evoke their genuine admiration and pleasure if they could see it. However modest he might be, the President had had a long experience in directing research and the Institution was very fortunate in having his services at just this moment. It was idle not to realize that everybody was standing before great events and changes, and all must be thinking about the part which the Institution would play in the future.

The Government had stated their intention of nationalizing the Gas Industry during the present Session and there was one aspect of this change to which he thought it was appropriate to refer, because it was a matter to which they should address their thoughts. This matter concerned the position and function of professional institutions such as the Institution of Gas Engineers in the new situation created by nationalized industries. He had chosen his words carefully. It could be assumed that a nationalized industry would be a good employer and would, besides organization, bestow a great deal of that coherence which was one of the things Institutions tried to provide for their diverse and independent members. There were other things which Institutions had done in the past which might possibly be done by the Industry itself when it was under one control.

A Free Forum Vindicated

"Are we, therefore," said Sir Charles Ellis, "to see a whittling away of many of the functions of the institutions, for each separate activity to be taken in turn and either gracefully yielded or tenaciously fought for? I think not. On the contrary, in the future I see for Institutions a more vital and important rôle even than in the past, and one which is so clear and simple that there is no need to worry about the details. Never was it more necessary to have strong and active learned societies, and this is the objective which the professional bodies should set themselves. A learned society provides a forum for discussion in which the only standard of merit is the intellectual one. Neither age nor executive position should add to or detract from this. I am a great believer in the full and free publication of results of unfettered and open discussion. Limits to this are set by everyday life just as in the more obvious way restrictions had to be imposed in wartime. These limits and restrictions are accepted by all, and subject to their proper observance there should be the greatest possible open-ness in the discussion and publication of our thoughts and our results. It is in this field that a learned society performs naturally an essential function.

"A learned society is a neutral body whose aims are the pursuit of truth and the deepening of the understanding. I can see nothing but good resulting from the activities of free and independent learned societies which cover the domain and work of nationalized industries."

Concluding, Sir Charles said that the past history and achievements of the Institution of Gas Engineers had fitted it most admirably for what he ventured to suggest was its rôle in the future. If all the wealth of knowledge at the disposal of the Institution was at this stage focussed on the aspect of developing a learned society on the highest possible standards, then the Institution had something that would ever redound to its credit.

A Vista of New Fields

Mr. **E. Crowther** (Vice-President of the Institution of Gas Engineers), responding to the toast, said it was inevitable that there must be an increasing degree of collaboration between the National Coal Board and the Institution. It had been announced that the National Coal Board was to give a high degree of priority to the work of the preparation and selection of the most suitable coals for the various markets, and he felt that so far as the market in gas coals was concerned, they would do well to avail themselves of the accumulated knowledge of the subject which the Institution could offer them in this matter. The business of buying and selling coal had passed from the old days when it was conducted on the principle, or lack of principle, of a game of poker. Now it was necessary in the national interest that the buyer and the seller should pool their knowledge and put the cards down face upwards on the table and bring all their experience to bear in order that the best result might be obtained and the right kind of coal secured for the particular job. He believed the Institution could help in this. They had done a great deal of work, particularly in the direction of extending the range of coals which could be carbonized successfully, and he believed that he could properly extend to Sir Charles Ellis an offer of the fullest co-operation, at the proper time, of the Institution in this phase of the work of the Board. The same principles must obviously apply in the coke oven section of his work, and he believed that until such times as the carbonizing industries were fully integrated and the logical conclusion of work that had been going on in recent years was reached, a fuller measure of collaboration between members of the coking industry and the Institution would be to the common good. The valuable work which the Institution had been able to do in the past had depended in great measure on the goodwill and, to an extent, on the financial support of the undertakings constituting the Gas Industry, but he believed it could be claimed that their support had been amply repaid. He believed also that in the future, as in the past, the support of those in charge of the Industry would continue to be more than ever amply repaid if it was extended to the Institution in the future, because they were entering into large new fields of work and activity as a result of nationalization. As an Institution they stood remote from the field of political controversy. They were not concerned with who were the owners of the Industry. Their sole concern was that whoever might be the owners, they as a professional body should continue to encourage and assist the members of the Industry through the Institution to render their highest possible contribution to the technical advancement and future development of the Industry.

Mr. **G. C. Pearson** (Immediate Past-President) proposed the toast of "The President," to which Dr. **Hartley** responded.

FUEL ECONOMY AT BIRMINGHAM

Birmingham Corporation has set up a Gas and Electricity Economy Committee which will be responsible for emphasizing the need for economy in the use of gas and electricity in the City. Under the Chairmanship of the Lord Mayor of Birmingham and with Councillor S. J. Brown (Chairman of the Gas Committee) as Deputy Chairman, the Committee will assist the Ministry of Fuel and Power in implementing locally the national drive to inform the public of the need for economy in the use of gas and electricity.

Your Business, the Corporation's monthly news sheet, stresses that industry must have the use of every possible unit of electricity and every possible cu.ft. of gas if we are to reach the export targets regarded as essential for England's recovery. This can only be done if all domestic and other non-industrial consumers in shops, offices, hotels, &c., co-operate, but everyone can help. Even switching off one element of one electric fire for one hour each day for one month can provide sufficient energy to enable one of the motor car factories in Birmingham to export another £25 worth of goods, returnable in the form of food, clothes—or maybe even basic petrol. Every possible means of publicity, Press advertising, posters, personal appeals, window displays and so on will be used to get the story over and the Committee will welcome any suggestions.

DISTRICT HEATING

SECOND REPORT OF THE DISTRICT HEATING COMMITTEE*

THE members of the District Heating Committee of the Institution of Gas Engineers are J. E. Davis, F.R.I.C. (Chairman); A. D. Billingham; G. C. Pearson, O.B.E., M.I.C.E.; N. S. Smith. *Ex officio*: The President, the two Vice-Presidents and the Hon. Secretary of the Institution. *Co-opted*: W. Hodkinson, M.I.Chem.E.; C. H. Leach, M.A.; C. E. Sanderson, B.Sc.; W. L. S. Spinks.

In its first Report the District Heating Committee† dealt in the main with the first part of its terms of reference,‡ considering "the principles and practice of district heating and proposals in relation thereto." At that time most of the data had to be obtained from published accounts of experience abroad and by consideration of the subject from first principles. Since the publication of that Report a number of detailed proposals for installations in this country have been advanced and the subject has been much under discussion; in this second Report the new information is considered in relation to the earlier conclusions.

The Committee has, however, given the greater part of its time to studying methods by which the Gas Industry can provide a service equivalent to district heating. It is apparent that the present popularity of the idea of district heating is at once a challenge and a stimulus to the Gas Industry, for the Committee believes that, by an expansion of existing methods and certain developments of a technical nature, in conjunction with an appropriate commercial policy, the Gas Industry can provide the desired service more advantageously than could be done by the creation of a new public utility for the supply of heat by the medium of hot water or steam.

PART I

Analysis of Further District Heating Proposals

The Committee, in preparing its first Report, had little factual information regarding district heating upon which to work. There was then, and there still is, only one district heating installation in Great Britain which has been in operation for a period and from which actual working data can be collected. This is the Dundee scheme.

A great deal has been said about this scheme, and many claims have been made. The Committee has long doubted the accuracy of the figures quoted, and it can now be stated definitely that the present charges of 5s. 6d. a week for a two-room flat or 6s. 6d. a week for a three-room flat are uneconomic and that the economic charge to the tenants at present would be approximately double these figures.

The final Report of the District Heating Sub-Committee of the Heating and Ventilation (Reconstruction) Committee, appointed by the Department of Scientific and Industrial Research, is still not available, but a forecast of the conclusions likely to be found in the Report can be obtained from the Interim Memorandum and the Memorandum on District Heating as Applied to Small Housing Estates, both of which were presented and discussed at the "Fuel and the Future" Conference in October, 1946. A session of that Conference, and of a later Conference arranged by the Scottish Fuel Efficiency Committee, were devoted to the subject of district heating, and great interest was aroused.

A Report has also been published by the Ministry of Fuel and Power and the Department of Scientific and Industrial Research on Domestic Heating in America. This Report has given much information of great value and, in particular, it shows the difference between heating methods in this country and in the United States of America, partly due to the difference in climate, partly to the very different method of construction of houses, partly to the requirements of the occupants, and partly to the difference in the fuels available.

While this Report gives rise to a number of lines of thought which may lead to useful developments in this country, it also illustrates that the development of heating systems must pay attention to the local circumstances and the customs of the people for whom the heating system is provided.

From the British Gas Industry there has appeared *Communication No.* 278/111 of the Institution of Gas Engineers, which describes in detail the service and type of installation which the Gas Industry offers for post-war housing. In addition to these publications, the Committee has had before it details of several housing schemes in which district heating has been under consideration.

After a careful study of this new information, the Committee is of the opinion that the conclusions reached in its first Report are still valid. There may be special circumstances where an unusually cheap source of steam or hot water can be made available and where the distribution costs of heat in this form will be unusually low, in the same way that there are localities in Great Britain where specially cheap gas is available. In the majority of housing developments of the smaller type, however, the economic charge for district heat at the inlet to the premises, *i.e.*, excluding the interest and maintenance on the capital involved in the internal installation, is not likely to be less than 9s. to 10s. a week, which, with the standards usually recommended, is equivalent to about 9d. a therm.

It is true that, in some projects, estimates have been put forward showing about half this figure, but these projects are not yet completed and in operation, and there are good reasons to believe that the costs will be higher than the estimates suggest, as has proved to be the case at Dundee.

The Committee feels that gas undertakings, in their own interest and in the interests of the community, will need to exercise the greatest vigilance when schemes for district heating are proposed in their locality, to ensure that such schemes are properly costed, due allowance being made for interest on capital, for payment of local rates and the overheads of management and supervision and for consumer service and collection of accounts, as well as a proper allowance for maintenance and amortisation. In some cases, in order to obtain full information on these points, the gas undertaking may require to participate in the scheme as suppliers of fuel, or even of waste heat, where the housing authority is not inclined to accept the more orthodox installation using gas and coke.

On the issue of coal conservation, the service provided by the Gas Industry can show better results than those expected from district heating.

In the Memorandum by the Ministry of Fuel and Power and Ministry of Works, it is estimated that space heating and hot water by a district heating system will consume about 4 tons of coal per household per annum. To this there will need to be added fuel for cooking, topping-up space heating, &c., and if these services are given by gas they are likely to add about 1 ton of coal to the requirements (if by electricity approximately 2 tons). This makes a total of 5 tons of coal per household per annum, whereas *Communication No.* 278/111 of the Institution of Gas Engineers shows that complete domestic fuel services can be provided by gas or gas and coke for a coal expenditure of $3\frac{3}{4}$ to $4\frac{1}{4}$ tons per annum. The adoption of complete gasification processes could reduce this figure to about 3 tons per annum.

It is important to bear in mind that the domestic heat service schemes put forward by the Gas Industry are comprehensive, whereas those provided by district heating cannot, by their very nature, be comprehensive, and require either gas or electricity to supplement them.

As pointed out in the first Report, where district heating is associated with electricity supply in a thermal-electric system, the credit for the use of exhaust heat is taken by district heating and electricity retains its disadvantage of being wasteful in coal when used for heating purposes.* In this connexion, it is valuable to bear in mind that the same amount of coal (after correction for difference in quality) is consumed in producing 1 therm of gas or 10 units of electricity, and this ratio should be used when seeking a decision as to whether gas or electricity is the more economical form of energy to use for a particular purpose.

It is claimed that the standards of heating provided by district heating schemes are much higher than those provided hitherto and it is implied that they are higher than those offered by alternative systems.

The first part of this argument is true, as the Gas Industry has well recognized. The standard of heat service in most homes is lamentably low, notwithstanding the high consumption of coal, but in modern installations, where gas or gas and coke provide a comprehensive service, the standard can be at least as high as that recommended for district heating schemes and can be higher where the tenant is prepared to use sufficient fuel. At the same time, the standards can be reduced by the tenant if he prefers to spend less money on fuel and more in other directions.

A comparison of standards is sometimes attempted by quoting the number of "useful therms" imparted to the building in the course of a year, and the Committee has noted that this employment of the term "useful therms" may be very misleading. The term "useful therms" was introduced by the Gas Industry in *Communication No.* 158 of the Institution of Gas Engineers, for comparing the useful result of similar appliances performing a similar function. The figure for any individual appliance is obtained by multiplying

* Communication No. 323, presented at the Autumn Research Meeting of the Institution of Gas Engineers, Nov. 25.

† First Report of the District Heating Committee 1945. Inst. Gas Eng. Comm. 286.

‡ "To consider the principles and practice of district heating and proposals in relation thereto and their developments through the methods of heat distribution which can be provided by the Gas Industry, and to report to the Council, with power to co-opt."

* The type of argument used to illustrate the possible fuel saving by thermal-electric schemes is as follows: If 2 tons of coal be used in a straight electric generating station, the use of a further 1 ton will make the equivalent of $1\frac{1}{2}$ tons of coal available as district heat; therefore the combined system saves $\frac{1}{2}$ a ton. This could be a fair argument if the electrical energy is required for a use where electricity is essential, but if the electricity is to be used for such purposes as cooking or heating, these services could be given by gas for the expenditure of only 1 ton of coal, instead of 2 tons required for electricity. In such a case the unnecessary use of an extra ton to do the work electrically, with the subsequent recovery of 1 ton as district heat cannot be called a *saving*, although it is a recovery of waste.

the thermal input by the thermal efficiency of the appliance in operation. Where continuous heating of a house is concerned, or the provision of hot water is under consideration, not all the therms put into the house or into the hot water are necessarily "useful." They are only "useful" in so far as they are used.

The District Heating Sub-Committee (D.S.I.R.) proposes to supply 575 therms a year to a small house for space heating and hot water: 182 therms per annum will be for the hot water and 393 therms per annum for space heating.

The maximum rate of heat input for space heating has been taken as 12,000 B.Th.U. per hour, with an extreme outside temperature of 25° F., and an average input over the heating season of 6,300 B.Th.U. per hour. It is stated that this would be sufficient to maintain the living-room continuously at 65° F. during average weather, with some heating in the hall and bedroom. Calculation shows that the heat input required for the living-room would absorb so much of the total heat input that the temperature rise in the remainder of the house would be about 3° to 5° F. This example is quoted to illustrate that apparently high standards in the form of total therms consumed per annum may not, in fact, mean a high degree of space heating at the time when heat is most required. At the same time, the discussion of these heating standards has drawn attention to the fact that, in the past, gas installations have not provided sufficiently or a small but continuous heat input to those rooms which are not in continuous occupation.

It has been noted that in some estimates for the cost of district heating schemes a substantial credit has been taken for an assumed saving in building costs. This means the omission of chimney breasts, flues and fuel stores. The Committee would point out that this saving in building costs is obtained only by limiting the consumer's freedom of choice in the type of appliance and the method of heating he will employ. If the Gas Industry considered it appropriate that a consumer's liberty should be so restricted, it could demonstrate that, by the exclusive use of gas as a fuel, similar savings could be made and very nearly to the same extent.

PART II

Influence of District Heating Upon Development of Gas Industry

In this part of the Report the Committee has endeavoured to put forward constructive suggestions concerning the attitude which the Gas Industry might adopt towards district heating proposals.

It is taken as axiomatic that if district heating should prove to be better, both technically and economically, than the service which the Gas Industry can offer, it would be most unwise and, in the long run, ineffective for the Gas Industry to place any hindrance in the way of its development. So far there is no evidence to suggest that either is the case.

On the other hand, the great interest displayed in this subject has shown how real is the desire for better heating standards, for more economical use of fuel, for the abolition of smoke and for a more completely automatic service. The Committee believes that the production, distribution and use of gas is better able than any other known form of heat distribution to satisfy this desire. To do so, however, will require a strong and sustained effort and a willingness to examine and, where necessary, modify existing practice, perhaps radically. If the Gas Industry fails to grasp this opportunity, the public may rightly desire district heating to be developed instead.

It might be thought that, since district heating cannot provide a comprehensive service, there is still room for gas to be employed in conjunction with district heating for cooking, for topping-up space heating, for refrigeration and for a wash boiler, but the Committee sees that this limited market would be subject to strong competition from electricity and it cannot be assumed that the whole of the available market would be obtained for gas, with the result that the consumption per dwelling served by the mains system would be low and the cost of supply, in consequence, high. Moreover, while the cooking load and the refrigeration load both offer a good load factor to the gas undertaking, their combined size is not sufficient to neutralise the exceedingly bad load factor of topping-up space heating. The peak daily demand for topping-up space heating could well be as much as the combined daily demand for cooking and refrigeration, but would be experienced to the full only when the district heating supply was unable to give adequate heating for comfort. It could be expected to occur, therefore, for a few days only at any time between mid-December and the end of February, a condition which would make manufacture both difficult and costly.

The Committee's view is, that as the gas mains and service pipes must necessarily be available to provide the supplementary services, they should be used to the full and, if used to the full, can provide a comprehensive service, which is more than district heating can do, and with an overall cost no greater than the combination of district heating plus supplementary services, either in money or in coal; it is believed that in many cases the overall cost should be less.

It is becoming more generally realized that this country cannot afford lavish expenditure on works of a capital nature. Published information on district heating schemes suggests that the capital expenditure on these schemes is likely to amount to about £60 per head of population. To provide a comprehensive gas service as visualized would involve the expenditure at present-day prices of about £23 per head of population. About half of this sum would be needed to provide gas to supplement district heating, and the capital expenditure attributable to providing the gas equivalent to district heating itself would, therefore, be about £12 per head of population.

The Committee suggests, therefore, that the Gas Industry would be well advised to have in mind the objective of supplying by gas a comprehensive fuel service, undertaking such work as may be necessary to develop appliances, controls, methods of manufacture and price structure as are required to make this possible.

PART III

Suggested Lines of Development

The Committee has given the greater part of its time to studying methods by which the Gas Industry can offer a comprehensive fuel service based upon the improved standards which are expected from district heating. In this part of the Report consideration is given to the standards which should be adopted, to the equipment required, and to the problems of pricing and manufacture which may arise in undertaking this type of development.

(A) Standards

It is recommended that a comprehensive service should provide basic heating of the whole dwelling, topping-up in the living-room and one bedroom, hot water supply, cooking, and a wash copper or its equivalent in the form of communal laundry facilities. While it is desirable that refrigeration and clothes-drying facilities should be provided, these two services are considered to be optional additions, not included in the minimum comprehensive service.

In order to compete in price, the average weekly cost for fuel and appliances for all these services must not exceed 14s. a week for a small house and 10s. a week for a flat, and preferably should be of the order of 10s. a week for the house and 7s. 6d. for the flat.

The Committee has considered that it would be helpful to make a definite recommendation on the standard of basic heating to be provided and the following recommendation is made, taking into account the fact that means for topping-up heating in the living-room and one bedroom will be provided. This topping-up will be by heat from a high-temperature source, either a gas fire or a coke fire, and the basic heating should not be so liberal that the use of such a fire would have to be reduced to an impracticably low level. Bearing in mind, also, that one main purpose of basic heating is to keep the house and its contents dry through the winter season, it is considered preferable to employ a form of basic heating which will give a specified temperature rise, rather than to maintain a constant indoor temperature.

It is recommended that the basic heating requirements should be calculated to give a rise in temperature of 10° F. in all rooms of the house when empty. This will result in practice in the minimum temperature at any part of the house being at least 15° F. above the outside air temperature for the following reasons:

Furnishings will reduce the heat loss below that calculated. Approximately half the heat lost from the living-room will find its way into the other rooms of the house, and other activities of an occupied house, such as lighting and cooking, will contribute something to the total heat input. A 15° F. temperature rise will be too much on many winter days, and the system should be designed so that the heat input can be reduced to half the maximum figure when the outdoor temperature is between 45° F. and 49° F. (normally for 60 days in the year), while the full heat input should be employed when the temperature falls below 45° F. (normally for 95 days in the year).*

Experience may suggest variation in these standards, one likely variation being that there may be a reduction to half heat input during the night hours.

With basic heating to this standard, the extreme minimum temperature in any room would be 40° F., with an outside temperature continuously at 25° F., and the fires for topping-up the living-room and bedroom should be capable of giving a 25° F. temperature increase. With the majority of small houses, gas fires with a heat output of 5,000 B.Th.U. per hour should suffice.

Where hot water is to be supplied under an inclusive charge, the Committee recommend that the standard of 220 gal. per week, at 140° F., should be adopted for the average family of 3.5 persons. It would be advantageous if the tenant could at will, by the expenditure of more money on fuel, obtain a larger quantity, but it is considered that the recommended standard is quite high enough for an inclusive scheme, *i.e.*, where a fixed periodic charge is made for the service, and that a higher figure would lead either to waste or to an excessively high inclusive charge. Members of the Committee, and others have prepared and calculated schemes giving approximately these standards and employing either gas and coke together or gas alone.

(B) Fuel

It seems likely that in the small house a modern coke grate with back boilers and convector will form the most acceptable basis. If

* These figures apply to Southern England. In Scotland and the North East Coast there will be more days at the lower temperatures.

a high surface back boiler is employed, sufficient hot water can be provided to supply radiators in the hall and bedrooms. The open coke fire provides the heat necessary in the living room for topping-up. Gas would be used for topping-up one bedroom and for summer water heating. Such a scheme would conform to the preference often shown for an open solid-fuel fire, though it must be recognized that one of the advantages claimed for district heating is that there is no need for solid-fuel handling or storage.

Schemes have been considered, therefore, in which gas is employed wholly for the heat service, being supplied under a two-part or block tariff, and, indeed, one practical experiment was made last winter when two similar houses were operated with conventional appliances one using gas and coke, and the other gas entirely. The difference in cost between these two and between other schemes which have been calculated is surprisingly small, gas being only 1s. a week more expensive during the severe winter weather. The difference would be much smaller on the annual average. It should be noted that the prices charged for gas were at existing rates and not special rates calculated for this particular type of business.

In the matter of flats the disadvantages of solid fuel become very apparent. It is difficult to make adequate provision or fuel storage, and when the height of the block of flats exceeds four storeys both the provision of flues and the delivery of coke to the dwellings offer great difficulties. It seems certain that unless gas can be used to provide a comprehensive fuel service, then in many cases housing authorities will be forced to adopt some form of heating and hot water supply from a central source. It is by no means certain that coke will be used for the central boiler house, because with modern automatic stoking equipment coal can be burnt conveniently and smokelessly. Automatic breeze-burning boilers might be employed in a few instances. Even assuming that the Gas Industry were successful in selling coke as the fuel for the central boiler plant, the remaining business for gas as a supplementary fuel would hardly be remunerative at present prices, bearing in mind the relatively small consumption possible and the nature of the load.

It is to be noted that if a solid-fuel fire is to be employed in any dwelling the consumption of fuel on that fire will be so large a percentage of the total fuel used that it should be used efficiently. Its efficient use demands the employment of a modern appliance which, even at minimum combustion rates, will put so much heat into the building that district heating becomes redundant. It follows that, from the point of view of efficiency, the solid-fuel fire and district heating are incompatible.

The Committee believes, therefore, that for blocks of flats a comprehensive scheme, employing gas alone, is essential, and foresee that development here may well lead to the adoption of a complete gas service in houses as well as in flats. It is not considered desirable that the attempt to develop this business should be through gas-fired boilers. To compete successfully, gas will have to rely upon the fact that it can be conveyed simply to the point where the heat is required. In this way the cost of the water-circulating system can be avoided and the heat losses inseparable from such a system can be prevented. These two saving together, combined with the absence of the boiler house and attendance on the boilers, as well as the absence of solid-fuel storage and the need for road access to the boiler house, may well permit gas to show an overall saving in money, notwithstanding its higher price per therm as purchased.

Consideration has been given to the desirability of using a coke-fired boiler for central heating and a gas-fired boiler for hot water supply. Such an arrangement would be very satisfactory to the gas undertaking, but far from satisfactory to the architect who would have to provide a dual system of hot water pipes and to make all the necessary provisions for receiving, storing and using coke. Having made such provision, he would surely recommend to the landlord that coke, the cheaper fuel, be used entirely.

(C) Methods and Apparatus

The problem of space heating houses or flats is not merely one of providing sufficient heat at the right time, but also of distributing that heat suitably throughout the dwelling. This may be done by hot water circulation or by air circulation or by liberating heat at the point of application. Where solid fuel is used hot water is the medium most likely to be employed, though, as instanced by the convector coke grate, hot air circulation may play a part.

It is known that in American houses much use is made of hot air circulation, and this is made possible by the typical design of American houses referred to in the Report on Domestic Heating in America as the "Open Plan," where doors to the living-quarters are omitted and bedroom doors are customarily left open in the day time. Obviously, such a design of house lends itself to air circulation more easily than the typical British dwelling, which would require an elaborate and expensive system of ducts to ensure uniform air distribution.

Nevertheless, there may well be changes in house design, and this possibility should be considered as capable of adoption in this country where house plans are suitable.

In present designs of house, and where gas is the fuel employed, the most promising line of development is heat released at the point of application. Where flues are available a gas fire of the purely radiant type, or, better still, of the convector type, makes use of this principle. So, also, does the flueless gas heater, but this latter type of appliance cannot be considered suitable for continuous basic heating of the house. Bearing in mind the difficulty of obtaining more than one or two flues to each flat in a block of flats, the Committee recommends that a strong effort should be made to develop the balanced-flue type of radiator. There was one example of this appliance on the market some years ago, and it appears to have given very satisfactory service, though the design is not in accordance with modern taste. Such an appliance, when brought up to date, should be installed beneath the windows of the dwelling, and the vent designed to blend architecturally with the window-sill. Bearing in mind the standards recommended for basic heating, such radiators should be available with heat-input ratings of 1,000, 1,500, 2,000, and 3,000 B.Th.U. per hour. If they were used as the appliance to provide the basic heating portion of an inclusive scheme they could be connected to a separate set of installation pipes and controls, the gas consumed in them being chargeable to the landlord's account. Similarly, the gas supplied to water heating apparatus, forming part of an inclusive scheme, would be charged to the landlord's account.

The Gas Industry already offers a wide range of apparatus for water heating, and for economy of fuel consumption it would be difficult to surpass the instantaneous multipoint water heater where it is practicable to provide an adequate flue for this appliance; its relatively high initial cost is offset by the absence of a storage cylinder. In an inclusive system it suffers from the disadvantage that consumption cannot readily be controlled and waste may occur.

For this latter reason, as well as because of the difficulty in providing flues, the storage type of heater may be preferred. This may take the form of a complete unit, or a storage cylinder with a gas circulator adjacent to it. The use of the gas circulator may be necessary where flue facilities are so restricted that it becomes necessary to place this appliance in a chamber sealed from the interior of the building and vented to the outside air. It will be necessary to ensure that circulators recommended for the heavier duty required of them should maintain their thermal efficiency for a long period and should not be of such a design that cold air circulates over the heat-exchange surfaces when gas is not burning. The adoption of a syphon flue principle may help in this direction. It is also necessary that the design should permit rapid replacement of the heat exchanger by a service unit.

If an apparatus of this type were to form part of an inclusive scheme for hot water supply, it could be clock controlled so that the storage cylinder was re-filled with hot water during times of low demand (say, at night), with a limited recovery period during the day and a high degree of control exercised over the fuel consumed.

A further direction in which development work is necessary is in the provision of automatic controls. It is desirable to eliminate even the small maintenance gas consumption in a water heater, and, if possible, the permanent pilot.

As it may be taken for granted that all future dwellings will have electricity available for lighting, the most promising line of development would seem to be the employment of electrical energy probably obtained at about 12 volts through a simple transformer, for operation of gas valves and ignition. Such a system would lend itself to remote clock control and also to thermostatic control of the basic heating, when outside temperatures rose to the point that half heating became desirable.

It may be considered that undue stress is being placed upon ventilating gas appliances through balanced flues or through sealed chambers built into the wall. The importance of such developments cannot be over-emphasized, for it is the difficulty in obtaining adequate flue provision which limits the installation of gas appliances more severely than any other single factor. The probability of a successful outcome in the directions indicated is seen to be high when it is remembered that the problem has been solved in the case of hundreds of thousands of gas street lamps.

Even with the adoption of such devices there will still be needed at least one flue per flat for the living-room fire, and preferably two flues, in order that one bedroom may have adequate heating to the full living-room standard.

In an eight- or 10-storey block, the accommodation even of gas fire flues is a difficult problem and there is need for further experiment on the design of gas-fire flues discharging into a common main flue, and for a better understanding of the means of avoiding down-draught, even though this may involve the provision of positive up-draught.

(D) Costs and Methods of Charge

The Committee has observed that housing authorities are showing increasing disinclination to meet the cost of gas service pipes and installation pipes, and this is understandable so long as they regard gas simply as an alternative to electricity for cooking and occasional space heating. If, however, gas is shown to be the best fuel for providing basic heating and water heating to the newer standards, change of attitude towards the cost of making gas available would be a logical consequence. There is no doubt that the attitude of housing authorities towards district heating is influenced largely by the consideration of the saving to them in housing costs from the elimination of fuel storage and flues. Where an all-gas installation is advanced a similar consideration applies. Fuel storage is no longer required and,

by the adoption of wall flues for radiators and hot water apparatus, the number of flues per flat can be reduced to one or two, and these of the smaller type which is suitable for gas appliances.

Where a housing authority accepts responsibility for the provision of heat from a central source, it accepts also responsibility for the maintenance of the appliances which use this heat. In the case of a hot water system this would mean radiators, storage cylinders and calorifiers and their controls. There seems no reason why, where gas is accepted as the medium for providing these services, a gas undertaking should not receive payment for maintenance of the equivalent appliances.

The extensive use of gas in the manner and for the purpose suggested may, for the reasons given above, relieve the gas undertaking of some financial burden, but it cannot come about without the offer of sufficiently attractive prices to the landlord.

The Committee urges that the economics of gas supply under the competitive conditions experienced to-day on new housing developments should be studied and compared with the economics of the position which would arise if gas were accepted as the fuel for a complete heat service. In this connexion it should be remembered that the gas undertaking, in respect of each dwelling, may be dealing with two consumers, the landlord and the tenant, the landlord providing part of the service and the tenant paying directly for the remainder.

The Committee has considered the appropriate division of responsibility between these two consumers and is satisfied that it is possible to exercise such control over basic heating and hot water supply that the size of the peak demand and the annual consumption can be estimated with reasonable accuracy. The consumption of fuel for cooking and for topping-up space heating is, however, very much at the consumer's discretion, and for this reason the Committee considers that supplies for this and similar purposes should be metered and paid for by the tenant. It should be possible also to arrange that where the landlord is supplying a limited quantity of hot water and the tenant desires to have more, controls should be such that the tenant can obtain an auxiliary supply through his own meter. The separation of the two accounts would make it possible to sell gas for the basic heating and hot water which the landlord supplies at a far lower price than the gas which the consumer can use at will, and the Committee believes that the objective should be to induce the landlord to accept responsibility for the standing charge of a two-part tariff, himself receiving gas at the lowest practicable price for the services which he provides, while the tenant pays for his gas at a somewhat higher price equal to the normal follow-on charge of the two-part tariff, which would itself be materially below the flat rate price of gas.

The Committee has given consideration to the possibility of tariffs combining gas and coke and applicable to schemes where both these fuels are used. The general form of such a tariff would be the payment of a fixed charge and the supply of either gas or coke or both in variable proportions at a reduced price. The intrinsic difficulty which has been seen is the fact that coke is portable and there is likely to arise a serious abuse of such a scheme by tariff consumers obtaining a coke allowance at the reduced price and re-selling it to their neighbours and themselves using gas also at the reduced price. For this reason the Committee does not advocate such systems.

(E) Manufacture

The proportion of the domestic space heating load at present carried by gas is small, both in relation to the total potential and in relation to the cooking and water heating loads. Nevertheless, the demand for gas for space heating produces considerable peak demands on gas manufacturing plant.

If district heating or central heating schemes are developed extensively and are not designed to take the maximum load in intensely cold weather, a quite uneconomic load of short duration will be passed on to the Gas Industry and its manufacturing plant. To a small extent this is experienced already through the operation of occasional gas heaters, in halls and bedrooms, which are employed only when the outside temperature falls below freezing point. The Committee recognizes that the Gas Industry cannot economically supply the marginal peak load which is rejected by others, though it believes that by taking the space heating load as a whole the peak itself will become relatively small in relation to the total volume of sales. At the same time it recognizes that the ratio of peak winter demand to summer demand will be increased and suggests that there is need for development on the manufacturing side, aiming at the provision of manufacturing methods which carry a smaller fixed annual charge per therm of maximum daily output than present processes. Further, the day-to-day variation in demand may be expected to increase with an increasing proportion of space heating load. This calls for consideration of plant flexibility and the possible development of long period storage.

With the presentation of this Report, the Committee expresses the view that the work entrusted to it through its terms of reference has been completed. It has reviewed and summarized the factual evidence available and presented that evidence for the use of those interested. It has suggested a line of policy which the Gas Industry may wish to adopt in the light of the proposals for and interest in district heating. Finally, it has recommended certain lines of development for examination and, if approved, practical application. The Committee desires to place on record its indebtedness and thanks to Mr. J. E Davis for his services in the preparation of this Report, and to the other members of the Gas Industry who have kindly submitted comments and suggestions during its drafting.

DISCUSSION

The Report was introduced by Mr. J. E. Davis (Chairman).

Mr. C. A. Masterman: The closer people are together the easier it should be to keep them warm and provide other services. And we know it can work out so in practice, for instance in hotels and in blocks of flats or offices. But suppose those buildings were first erected and each occupant then left to make his or her own heating arrangements. That in principle is just what has happened in the past when we consider the heavily built up city centre. There has been no planning of the heating services for the area as a whole. Now that is just what district heating purports to do, to make use of the fact that a lot of people are living close together to effect an economy of effort, of fuel, and of expense.

District heating by hot water or steam has many times been presented as deriving either from the heat otherwise wasted in electricity generation or from central boiler plant of over 80% efficiency, and consequently economical of fuel. Costs are low and of predetermined amount, heating standards high, no flues or servicing are needed, and there are no bothers of any sort. I do not say that is the claim of responsible advocates but it tends to be the popular picture.

Never has there been such a time as now for planning; never has such official interest been taken in heat services; never have there been such wide powers available. So it is more than ever urgent that full information be published on this matter so that the decisions taken are truly in the public interest, and that appropriate fuels and services be used in each case.

These reports, of which this is the second and last, will presumably be consulted as reliable guidance on what the Gas Industry can offer. In effect they seem to say two things. First, in quite general terms they claim the Gas Industry can usually do as well or better than piped steam heat. But if that be so why is it there are no real examples here or overseas quoted in the report? If in the past there have not been adequate powers, what powers are needed? There are plenty of examples of piped steam and hot water overseas. Secondly, this report seems to detract from the general claim by stressing certain difficulties. Special balance radiators (yet to be perfected) must be used even to ensure a heat input corresponding to 2 or 3 cu.ft. of gas an hour. There are dangers, as presumably with piped steam there are not, associated with seasonal load factor; even clock controls to avoid the daily peak are envisaged.

Whether we are in the Gas Industry or not, we should all be concerned as citizens that the best use be made of the various fuels and services. It would be as anti-social for the Gas Industry to exaggerate its difficulties as for it to exaggerate its claims. We must all recognize that both gas and electricity acquire a much increased efficiency compared with less flexible fuels where the demand is intermittent—they can be used just as required. But so far as that demand is for topping-up it worsens the load factor. A basic load helps the load factor and reduces costs but reduces also the advantage which a flexible fuel possesses. From the manufacturing and distribution point of view you might wish the public to use gas for the basic demand and solid fuel for topping-up, but that does not seem practical politics.

If we agree that no authority nor persuasion can transfer the topping-up demand on to solid fuel or piped steam, then it must be accepted by the gas and electricity industries. So the Gas Industry assessment of the district heating problem in terms of gas is not acceptance or non-acceptance of a seasonal peak but whether that peak shall or shall not be diluted with a heavy basic load. (I omit the possibility of a general conspiracy among the public utilities to forbid the public any additional heat in very cold weather!)

Let us briefly re-examine the circumstances. An area is to be provided with basic heat supplies. Since acceptance of these is obligatory there is a predictable demand of high density. In the case of gas some at least of the manufacturing and distribution equipment already exists (an important factor in the national economy). Supplementary to the main cost comparison, the difference in cost of the topping-up load, whether with or without a heavy basic load, might be substantial. Meanwhile the price of gas to the rest of the area supplied by the undertaking might be profoundly affected by the decision whether the densely populated centre becomes a virtual gas black-out or an area of very high demand.

To these several questions I have no answer. But I conceive the authorities want the answer, and I don't think they will readily get it from these reports. So I strongly urge that the Committee be not allowed to pass out of existence, though as a past member knowing their difficulties, I sympathize with their expressed desire to do so. Their future task, as I see it, is to co-operate with undertakings which have opportunity to prepare definite plans for specific cases as alterna-

tives to the supply of piped hot water or steam, and to publish the information for the benefit of all. The problem is complex but perfectly rational and likely to remain a live issue. With great respect to the Committee and fully mindful of their difficulties, I suggest these reports leave the practical man in much doubt whether the Industry really has anything to offer in this field or not.

The **President**: I may say that although the Committee has asked to be disbanded that desire has not been granted.

Force of Tradition

Mr. **W. K. Tate** (Portsmouth): Comments are not unknown which suggest that the subjects covered at the Institution's Autumn Research Meeting are sometimes so abstruse as to be somewhat outside the grasp of many members, but no one can level any such criticism at this report. It is clear, concise, and to the point, dealing with a subject of wide interest in a manner all can understand, and I would not wish to question any part. What I do wish to do is to draw attention to certain particular points which I feel are of immediate concern in formulating any policy of competition with district heating by hot water and steam.

In the first place, would-be reformers must never forget the deeply ingrained and traditional customs of those towards whom their efforts are directed. It is of little use to attempt a revolution in domestic comfort conditions overnight, since personal preferences and habits die hard and standards which may be acceptable under other climatic conditions with different building constructions are not necessarily called for in this country. The popularity which any scheme of district heating might have with its consumers and consequently the amount of use which, in practice, would be made of it, must have a very real bearing upon its economic success or otherwise.

For some years now there has been talk of the " all-gas " house, but have we grasped the full implication of such a desirable thing upon our Industry, when reproduced in great quantity? We may even have experimented with full-scale models and acquired a local though restricted understanding of their effects, but the likelihood of a general adoption of such a project over a wide area has seemed so remote that the necessary expansion of the Industry has perforce remained within the realm of almost visionary planning. The arrival of district heating, however, in the accepted sense of that term, relates the all-gas house to a real physical alternative with which it is comparable and may be shown to be favourably so. In other words, the all-gas house is now practical politics and how practical the report conclusively demonstrates.

Men of Vision

At the present time the day-to-day difficulties of conducting a gas undertaking press heavily upon the executive staff, while the trend of all prices is a cause of discouragement. Nevertheless the Industry possesses men of vision and even the expenditure that would be called for in the provision of an all-gas service on a large scale can be assessed —as it must be assessed—in order to build upon the foundations which must now be laid.

With a very proper desire to improve the living conditions within their many planned building developments, some local authorities have apparently turned to district heating as a means to this end. Have they done this on the grounds that no other alternative exists; that district heating by hot water or steam is economically the most desirable or because district heating is something new which consequently shares in the glamour that seems to attach to electricity in its competitive relationship with gas? It is difficult to tell, but surely whatever the reason, this report has set out the basis of the Gas Industry's justifiable reply and early steps should be taken to conduct a suitable campaign, both on a national and a local level, to convince the housing authorities of to-day that gas can not only offer a comparable service but a comprehensive service, and that the costs for this complete service should be less than those of the otherwise inevitable mixture.

The adoption of gas for all services is almost certainly conditional upon the introduction of economic two-part tariff systems of charge, the formulation of which in individual instances should not be impracticable, once the magnitude of a given project is ascertained, but the division of charge between landlord and tenant is likely to be contentious. I confess to being considerably attracted by the Committee's suggestion in this regard, although I have not yet had the opportunity of analyzing the statistics set out in the appendices. At this time, also, I would not wish to put any questions to the Committee on matters of interpretation, other than to say that personally I cannot quite understand the sixth paragraph in Part 2, where it is stated that the comprehensive gas service would involve the capital expenditure, at present day prices, of about £23 per head of population, as compared with £60 for a district heating scheme. These figures are absolutely vital in the presentation of any case and I should be grateful indeed if the Committee could see their way clear to elucidate the text and set out in some detail the manner in which they have arrived at their assessment.

This second report is a worthy successor to the first document upon the subject and in fact we are given here a most excellent foundation upon which to build. In their closing remarks the Committee indicate that their work is done and within their terms of reference this is so. On the other hand much still remains to be done in the future as district heating schemes come into being, so that the Industry may be in a position to readjust its outlook in the light of known experience and no one could maintain a better watch than the present District Heating Committee, with their detailed knowledge arising from the preparation of the two reports. May I suggest, therefore, that this Committtee be asked to continue and to hold a watching brief on the part of the Industry, being thereby in a position to report from time to time, as the occasion demands.

Liverpool Scheme

Mr. **H. P. Lupton** (Liverpool): In the unavoidable absence of Mr. Leach, it has been suggested that I should make a few comments on the Liverpool report which appears in an Appendix. The equipment in the two houses on which tests were made was equipment already available in the houses and it had not been installed as the Company's idea of what should be found in a model house.

The report was prepared solely as an indication of the approximate cost of fuel to obtain the quantity of hot water and the recommended temperature rise in the house.

Gas used for water heating and for cooking, refrigeration, &c., was not metered separately, and several assumptions have had to be made in order to obtain some of the figures. Thus it was assumed that the coke fire had a radiant efficiency of 25% and that the gas circulator had an efficiency of 50%.

It should be further noted that the gas-cum-coke house was not ideal for the test, as the house had been badly blitzed at one time, and doors and windows, as a consequence, were far from being draft-proof. The consumptions obtained from this house would undoubtedly be decreased on a well-constructed dwelling.

When compared with much of the technical information in the District Heating Committee's report, or in any reports to which reference is made, some interesting points can be made. Thus:

(1) The annual fuel cost of the all-gas house compares very closely with the all-gas house quoted in Communication 278 when allowance is made for the difference in the price of gas.

(2) The cost of hot water production in the gas-cum-coke house during the summer months was excessive, due to the very low boiler efficiency and the fact that the solid fuel fire was lit for a few hours every day. The method of heating water in an evening for use the following day was unsatisfactory, as the temperature of the water by mid-day was too low for satisfactory dish-washing. A certain amount of water had to be heated on the cooker.

(3) The maximum rate of heat input for space heating of 12,000 B.Th.U. per hour seems to be very much on the low side. During the winter test, the gas consumption at one period in the all-gas house was 800 cu.ft. in 14 hours. Allowing for water heating, this would indicate an input of some 23,000 B.Th.U. per hour for space heating.

In the gas-cum-coke house, the consumption for one 24 hour period was 1,600 cu.ft., or some 30,000 B.Th.U. per hour for space heating, without any account of the input from the coke fire.

The average input during the heating season for the all-gas house was 5,000 B.Th.U. per hour, against the quoted figure in the report of 6,300 B.Th.U. For the gas-cum-coke house the average figure is about 6,050 B.Th.U. per hour.

(4) During the tests no complaints arose regarding the use of portable radiators so far as odour or condensation was concerned. The frequent regulation of the various appliances, however, was an objection, and it was felt that all basic heaters should be on a separate installation line from that supplying the topping-up appliances. The basic heaters should be controlled from a room thermostat fixed, say, in the hall.

(5) As the two houses under test were some 50% greater in floor area than the dwellings considered in the report, and as the fuel cost in each case was approximately 10s. per week throughout the year, it was felt that the requirements of the Committee regarding an economic charge could be met.

I am only prepared to deal with the technical side of the Liverpool tests, but I understand that my Company has in mind the possibility of suggesting a tariff for gas used on an all-gas housing estate, the price being of the order of (*a*) a standing charge of 1s. 6d. weekly plus (*b*) a commodity rate for gas metered for 6.8d. per therm.

A Disappointment

With regard to the main report, it is rather disappointing to find that the Committee is not prepared to put forward a concrete scheme for an all-gas house. I am not at all sure that the housewife would regard a balance radiator in each room and in the hall with favour. Such radiators would be fixtures and would certainly be in the way, besides being not too easy to light unless she left the by-pass going throughout the heating season. What would be the efficiency of such a radiator?

I should like to know more about the objections to a gas-fired unit providing both hot water and central heating. Surely an ename gas-fired central heating boiler and a circulator of attractive designs could be placed in an alcove in the dining room and the system be so designed as to give a satisfactory service.

I have inspected the Urmston district heating system and a combined warm air and hot water system known as the " Warmaire " system. In each of these installations the housewife has merely to turn on the hot water tap if she requires hot water and to open or close a valve if she wishes to adjust the space heating system so far as the basic heating is concerned. The gas-fired

central heating and hot water system mentioned above corresponds much more closely with this method than does the method proposed by the Committee of having single radiators scattered about throughout the house.

I was very surprised by the suggestion that permanent pilots should be abolished and replaced by an electric ignition system and complete shut-off. Some gas appliances would be difficult to light up without an occasional failure. How would the Committee guard against such failure ?

The Committee seems to be greatly disturbed by the question of ventilation, and I agree that for topping-up appliances such a question is important.

Recent Weather Phenomenon

Last week I had a very interesting experience. You will remember that the newspapers and the wireless made a feature of the dripping ceilings and running walls experienced by thousands of householders when the weather suddenly changed from cold conditions to a warm humid state. During the cold spell I decided to put into service the flueless heater in my hall. By this means I raised the hall temperature by several degrees and also warmed the upper floor. When the change to warm conditions occurred, there was no sign of moisture deposition in any part of the house. This experience, I feel, does not support the Committee's disapproval of flueless heaters. I should add that there are five flues in the house.

The volume of the type of house considered in the report would be approximately 8,000 cu.ft. If the houses are of the semi-detached type, the real heat loss for a 10° F. difference in temperature between outside and inside is estimated at approximately 12,000 B.Th.U. with two changes of air. Such a loss would be made good by the complete combustion of 24 cu.ft. of 500 B.Th.U. gas. This consumption would be divided between seven or eight heaters. If the whole house is warmed in this way there would be no need to close inside doors, and it seems that there must be something very wrong with the ventilation of the house if trouble from condensation occurs.

In conclusion may I compliment the Committee on the two reports they have produced. They have given the Industry a very complete view of the position, and, from the facts given, individual undertakings should be able to formulate their own plans to meet any competition from district heating schemes.

An Uneconomic Load Eactor

Mr. G. H. Fuidge (South Metropolitan Gas Company): It is satisfactory to learn from the Second Report that the Committee is still of the opinion expressed in the first report that a strong case can be made for the use of gas and coke as an alternative to district heating to provide the improved standards of heating required in future blocks of flats and housing estates.

The Committee has emphasized the danger that district heating would leave to the Gas Industry the very uneconomic topping-up space heating which has such a bad load factor. There is already an unfortunate tendency for gas to be used in this way, as Mr. Birks, in his discourse to the Fuel Luncheon Club, showed when he referred to evidence that the gas heating load increase with the degree days not directly but to the power of 1.4. What might happen with district heating is wel illustrated in the present report. I believe that the Committee is right in advocating that gas should be used to give a complete heat service, for although this would give a rather large variation between the summer and winter loads, the peaks during very cold weather would represent a much smaller proportion of the total. From the point of view of load factor to the Gas Industry, the best method of using gas for space heating would be to use it to provide background heating using solid fuel to deal with the peaks, although as pointed out in the report, solid fuel cannot be burned in an open fire at very low rates and therefore from such an appliance the heat output will often be very much more than is required. The results would be more satisfactory if the solid fuel were used in the modern openable stove with a back-boiler, for in such an appliance quite low rates of combustion can be maintained and a large proportion of the heat can be directed into hot water rather than into space heating.

Whether gas is used to give only back-ground heating or complete space heating we fully agree with the Committee that new forms of convector heaters which do not discharge products of combustion into the room are required. Although gas can be used in central boilers, almost its only advantage over solid fuel when so used would be in the reduced labour in the boiler house; there would be no reduction in capital costs and no reduction in transmission losses. The great advantage of gaseous fuel that it can be conveyed easily to the point where the heat is required cannot be over emphasized. Thus direct fired gas radiators would avoid transmission losses and should markedly reduce the capital costs of the installation.

Laboratory Experiments

In my Company's Laboratories we have already carried out some preliminary experiments on the development of gas convector heaters on the principle of the balanced flue radiator marketed by the Davis Stove Company some years ago. We have already constructed some experimental heaters having heat outputs of the order of 3,000 B.Th.U. and there seems no difficulty in obtaining efficiencies of over 70%. The flue terminal carrying both the incoming air and the outgoing products has the dimensions of a standard building brick, so that it should be quite unobtrusive in the wall of a house or a block of flats. So far as the laboratory tests go, the efficiency of combustion and the stability of the flames are not affected by winds from any direction having speeds up to nearly 40 miles an hour—conditions rarely met with in towns.

It is, of course, realized that much more work is required before it can be said that this form of heater is practicable, and we have arranged for field tests in order to study the effect of those conditions that cannot be reproduced in the laboratory. We are encouraged to believe that a solution of the problem will be found by the information we have obtained about a similar appliance which has recently been developed in America, called the "Safaire"; this has been approved by the American Gas Association and is claimed to give entirely satisfactory results.

The heat output of the heaters on which we are working may sound unduly low, but this output is on the upper range of the rates recommended in the Committee's report. It is perhaps necessary to emphasize the extremely low ratings which are required for back-ground heaters in a building which is heated throughout. The reduction of heat losses through the inner walls, floors, and ceilings is very considerable; for example, in a recent examination of a large block of flats it was found that the heat losses from the living rooms ranged from 118 to 172 B.Th.U. per hour per ° F. with an average of 145 B.Th.U. per hour per ° F. To provide a 15° F. temperature rise in these rooms requires not more than an average of 2,200 B.Th.U. per hour, which would be provided by a heater of only 70% efficiency with an input of 3,000 B.Th.U. per hour or 6 cu.ft. of 500 C.V. gas. The amount of heat required in the bedrooms, &c., would, of course be still lower.

The provision of a complete heat service is an entirely different problem to those which the Gas Industry has dealt with in the past in connexion with space heating and hot water supply, and calls for a complete reorientation of ideas. Not the least important contribution made by the District Heating Committee's admirable report is that it has placed this issue squarely before the Industry.

Desire for Variety

Dr. C. H. Noton (Ministry of Fuel and Power): The chief impression that I gain from reading this new Report by Mr. Davis, and the First Report of his Committee, is that the Gas Industry is alarmed at the prospect of being left with only the peak heating load to carry, after district heating has met the whole water-heating load and the base space heating load. Now, surely this is exaggerated ? In the first place, the British character being what it is, district heating is never likely to account for more than a small proportion of domestic heat supplies: we are much too fond of variety to accept a wholly district-heated future. Secondly, there will still be a big cooking load for gas to carry. And, lastly, if the impression prevails outside that gas space heating is a peak hour form of heating, the Industry has only itself to blame, since the bulk of the Watson House propaganda to prove that *intermittent* gas heating is as cheap as coal heating has simply stuffed this impression down people's throats. The Gas Industry cannot have it both ways; gas may be cheap if used intermittently, but it cannot then also be a base load carrier. As for coke and its future in a partially district-heated world, even the houses in Dundee and Urmston still receive their household fuel allocations—why should those, and the deliveries to future district heated houses, not be coke instead of coal ?

More serious than this technical and economic criticism, however, is the political attitude of the Gas Industry to district heating. It must be widely known now that the Gas Industry wishes to see some formal regulation applied by the Government to district heating. This, it seems to me, is like trying to run with both the hare and the hounds. On the one hand the proposed Government control of the Gas Industry is condemned, and on the other Government controls are advocated for district heating. I should have thought it obvious that the present Government, as a part of its general policy, would apply some sort of regulation to district heating as soon as there was something there to regulate—but at the moment there *is* nothing substantial to regulate, and no basis on which to formulate regulations. Consequently, I should think that pressure by the Gas Industry for official control of district heating is likely to form suspicion in official minds, and postpone rather than advance the day when regulations are formulated—as they undoubtedly will be—for this public service just as for any other.

In my opinion the Gas Industry will be wasting its time if it opposes district heating in ways like this. District heating has now won political favour in this country, after a long struggle, and is not likely to lose it unless and until it is proved hopelessly uneconomic for British conditions. For this reason, if for no other, it would be better or the Gas Industry to meet this method of heating half way, and try to guide—not drive—it along lines of development beneficial to *all* concerned.

Mr. J. H. Dyde (Slough): I should like to refer to the statement in the report which reads as follows: "In present designs of house, and where gas is the fuel employed, the most promising line of development is heat released at the point of application. Where flues are available a gas fire of the purely radiant type, or better still of the

convector type, makes use of this principle. So, also, does the flueless gas heater, but this latter type of appliance cannot be considered suitable for continuous basic heating of the house."

I feel that the Gas Industry is rather playing hot and cold on this question of flueless heaters. Only two or three year ago we advocated background heating of the flueless type. I do not know whether the Chairman and gentlemen who produced this report had in mind also the work of the Gas Research Board on organic sulphur and the fact that they had found it extremely difficult to reduce the content to between 5 and 10 grains, and even that involves either oil or carbon scrubbing, associated with a catalytic process—that is, unless the thiophene can be made to react to a catalytic process and eliminate the oil or carbon scrubbing. However, I feel that each one of us should face this. If you are putting background heating in your living room, would you actually discharge the products of combustion into that room? How does this compare with the more orthodox type of heating applied to a hot water system? I say there is no comparison. On the other hand, the Committee goes on to state: "Bearing in mind the difficulty of obtaining more than one or two flues to each flat in a block of flats, the Committee recommends that a strong effort should be made to develop the balanced-flue type of radiator." That is like pulling out an old chestnut. This type of radiator was developed, I believe, in the late 20's particularly for use in garages and in certain halls where fire regulations were particularly stringent. The idea theoretically is quite good. It eliminates the difficulties associated with static pressure and aeromotive force in the column and has a modifying effect on the intake of air and improves combustion. Moreover, the appliance itself is perfectly sealed from the air in the room. I had occasion the other day to remove one of these radiators and I examined the flue system which went through the wall and ended in some mushroom type of extrusion, and it was completely caked with deposit arising, of course, from condensation and action on the metal—which was actually cast iron—of which the pipe was constructed.

There is no doubt that if this type is to be developed we must face considerable difficulties due to condensation. I suggest that if this type of appliance is developed in a modern artistic and pleasing fashion it will have to terminate in a balanced type of flue terminal which must be built in integrally with the complete structure. In that respect, of course, you will have to eliminate the inertia of the architect, which will be no small matter, and, what is more, you will have to produce a terminal which is impervious to moisture and also resistant to common forms of corrcsion which we know always arise from the combustion of gas. Furthermore, you will have to make it so that it can be easily cleaned either by access from the exterior or else from inside the room, which will mean some easy means of removing the actual radiating or convecting appliance and getting at the flue. Although I seem to be making a complete case against the development of the balanced form of radiator, I do feel that the idea is a good one and that it should be developed.

We must not get the idea that district heating is something that we should be afraid of and which will take from us a very essential load. That is not the case. There are many parts of our districts which can never be influenced by district heating, but the development of an appliance of this type might be useful in many parts where district heating could not be applied as such.

Mr. Davis Replies

Mr. **J. E. Davis,** replying to the discussion, said: The Committee's report has been criticized most helpfully and in several different ways. It is said, first of all, that it is inconclusive. I agree. There are one or two recommendations in the report but no recommendations of complete schemes. One of the recommendations is that we should learn a little more about balanced radiators so that we do not have to have a flue from the bottom to the top of every block of flats. This is a positive recommendation and it is clear that a little more explanation is needed. Mr. Lupton does not like the idea of radiators scattered all over the house. He thinks the housewife will find them troublesome, but if she has a centrally heated boiler she will still have radiators all over the house and a knob to turn. What we suggest is that instead of water pipes there should be gas pipes, and that in order to avoid having to turn little knobs there might be a wire running to each radiator so that the system would be completely automatic. There is a great deal, of course, yet to learn, and I hope that both this Second Report and also the First Report will be regarded as not the final word on anything but rather as bringing to the attention of our Industry the fact that to-day's demands for heating standards are different from what they were. Some people are thinking hard on this matter and they are going to meet the demand. Are we going to say that we cannot do it? I do not think from the evidence that there is any reason why we should say we cannot do it, but we might say it is going to mean a lot of work.

It has been asked by Mr. Masterman why gas has not done this before. It is a fact that before the war many people who could well afford central heating did not have it because in this climate they thought it hardly worth while bothering about, but if it is to become fashionable to provide a part of the rent in heating and it is to be subsidized, then central heating in houses will become more popular, and I think gas will fulfil the demand even if it did not fulfil it before.

When we come to the question of peak load and basic load, I am grateful for what Mr. Masterman said. We cannot touch the peak load and we do not touch it to-day. We all know that the flueless heater is brought into use when the outside temperature falls below freezing and it is left on day and night until it stops freezing. This constitutes peak load business, and the question is not whether we shall have the peak load or the basic load but whether we shall have the basic load in addition to the peak load which people are rapidly giving us. And there I say I am grateful to Dr. Noton for his remarks. I do not think anybody imagines a wholesale district-heated future for this country, and I was hopeful that the Committee had been at pains to make it clear in their reports that district heating must be considered only in relation to the facts, both technical and economic, in each particular case. To say we do not like it and that it must be stopped is merely foolish. It is, perhaps, the Gas Industry's own fault that it is considered by other people to be suitable for peak load heating only, but I think that is where gas shows to the greatest advantage.

In regard to flueless gas heaters, Mr. Dyde has touched on a thorny question. I do not think the troubles with the flueless gas heater when used for continuous basic heating are nearly so much a matter of sulphur as of moisture. The removal of sulphur down to 10 gr. per 100 cu.ft. is practicable and people are doing it, but even when you have done that, you have not removed the moisture which is formed. If the whole of the building is to be heated by flueless gas appliances, I should not feel happy in recommending them from the point of view of moisture.

ILLUMINATING ENGINEERING SOCIETY

The Illuminating Engineering Society has arranged to hold a Summer Meeting from June 16 to 19, 1948, at Harrogate. Papers will be presented on "Decorative Lighting," by L. H. Hubble; "The Design of Fluorescent Lighting Installations with special reference to the Textile Industry," by E. Smith and T. C. Holdsworth; "New Lamp Developments," by N. L. Harris; and "The Application of Acrylic Plastics to Lighting Equipment," by Dr. W. E. Harper and Mr. Walker.

The programme includes the annual general meeting, following which it is the custom of the Society to invite some prominent scientist to address the members. On this occasion the address will be given by Mr. Ward Harrison, Director of Engineering to the General Electric Company of America, whose contributions to the study of illuminating engineering are well known. A lecture and demonstration on television is to be given by L. C. Jesty, of Cinema Television.

The meeting has been arranged to precede the meeting of the International Commission on Illumination, which will be taking place in Paris at the beginning of July. It is hoped, therefore, that a number of delegates from other countries who will be attending the latter event will also be present at the meeting at Harrogate.

GLOUCESTER PROFIT SHARING

Moving the adoption of the report and accounts at the annual meeting of the Gloucester Gas Light Company's Profit Sharing and Saving Scheme, Mr. A. T. Voyce, one of the Directors on the Committee of Management, said the Board had this year granted a bonus of 2% on wages and salaries earned by the employees who were members of the scheme. The total bonus to be shared amounted to £1,634 compared with £1,260 in 1946. Membership had increased to 356 due to the admission of new employees. Savings by members during the year had amounted to £3,737.

The report stated that the price of gas during the year was 1s. 2½d. a therm, and according to the rules no bonus was payable. The Directors, however, had declared a bonus of 2%.

This point was amplified by Mr. F. W. Rogers, who pointed out that the investments were not sufficient to pay the total interest to the employees. Therefore the Company had made up the balance of £577.

Mr. Voyce said a Co-partnership Committee had been set up in London by the London companies and others, and delegates had been appointed to interview the Ministry of Fuel and Power in order to discuss their case for "co-partnership." Contact had been made and the delegates were now awaiting an early appointment.

In view of the success and popularity of the Gloucester Gas Company's scheme, he hoped that the scheme would either be retained as it was or still further improved. He reminded the meeting that the British Gas Council intended to oppose nationalization, which in the words of a statement issued by the General Manager was described as a "political project as untimely in present circumstances as it was unjustifiable."

Mr. Rogers said the British Gas Council was trying to get some clause into the nationalization Bill to protect co-partnership and contributory pension schemes.

Coventry Gas Department hopes to be able to supply gas to Nuneaton by the middle of January. The City is also to supply gas to Birmingham and Rugby; it is hoped to supply Rugby by the end of the year. Only a mile of the Coventry-Birmingham pipeline remains to be laid.

PRICE STRUCTURE OF COAL AND ITS RELATIONSHIP TO PREPARATION AND UTILIZATION

CONTRIBUTING to the discussion on the Paper on this subject which Dr. E. S. Grumell presented to the East Midland Section of the Institute of Fuel on Oct. 24 (a special abstract of which was published in the "JOURNAL" of Nov. 19, p. 401), Mr. **C. Johnson**, A.M.I.C.E., M.Inst.Gas E., expressed the point of view of the Institution of Gas Engineers.

He said Dr. Grumell had presented a fascinating and highly controversial subject and the Paper might be regarded as the culminating point of the logical sequence of very thoughtful work he had done for the coal industry over a considerable number of years. A long time ago he had recognized the need for coal samples to be properly taken and tests to be standardized in an endeavour to get comparable results between individual workers, and the preparation of the British Standard Specification for Coal Sampling and Testing owed a lot to him. A year or two ago a conference of the Institute of Fuel in Manchester on consumers' coal requirements had a most valuable contribution from Dr. Grumell, around which a widely representative body of opinion had discussed the coal problems of the majority of our more important industries. More recently Dr. Grumell had given a further valuable contribution on the washability of different coals and had included the economics of process efficiency without which his work would have had little more than academic interest. Now we came to the most formidable task of all, the appreciation of the value of individual coals according to type and grade and the planting of those values upon consumers in the manner best calculated to make them stick.

Dr. Grumell hoped that a rational price structure would simplify the preparation of coal and therefore offer opportunities of reducing the cost of preparation. Should we not reverse the order of things and consider that a simplification of coal preparation would assist the building up of a relative price structure? A reduction in the number of prepared grades would cheapen the cost and offer possibilities of a reduced selling price—surely not too remote, and we just could not resign ourselves to endless price increases.

Five Main Objects

The five main objects of Dr. Grumell's Paper, as set out in the introduction, were most worthy, but seemed under present circumstances just a cherished ideal. Ten or 15 years ago the standard of coal preparation attained was, broadly speaking, as good as consumers could justifiably hope to expect, and that was the time when the coal industry should have evolved a system of integrated prices for the respective qualities of coal inter-related between producing districts. How different and how much more difficult was the position to-day and, frankly, how inopportune to work out a system of relative prices when there appeared to be no stable foundation on which to build. The great urge for increased coal production and the very general evidence of relaxation of standards in coal mining and cleaning had greatly confused the relative merits of most coals and it was going to be extremely difficult to build up a system of marginal differences of value without knowing what degree of improved quality could be achieved. Over some period of time the average analysis of every coal and every grade would have to be agreed and fixed to establish a set of basic values. Variations from that must inevitably be wide under to-day's conditions, and because no other improvisation could be thought of it would have to be the primary responsibility, and an early one, of the National Coal Board to get coal quality back to normal.

Adequate Standards

Up to now the coal industry, particularly the merchants, had marketed coal with but scant technical knowledge and many scientific and technical people must have received a considerable number of shocks during the past eight years in dealing with other people's reactions to coal quality. Undoubtedly a vast amount of impurity had been sold as coal and unsuitable grades sent forward for particular processes. On the other hand, customers had been fairly reckless in their allegations about coal quality. In many instances that had been due to poor practice in the matter of sampling and testing, and there was still a great need to educate the vast majority of consumers to the meticulous standards required to test coals with sufficient accuracy to discuss their properties without fear of embarrassment. The standards laid down for the sampling and testing of coals were reasonably accurate and certainly adequate in the hands of knowledgeable people.

To what extent the general mass of consumers knew what kind of coals they were getting and knew precisely what they wanted was hard to define, but the position was not as bad as some suppliers would have us think. It could safely be said, however, that the bigger the consumer of coal the greater the knowledge he had of what he was actually getting. That was certainly true of the Gas Industry, and there was no doubt that when the Ministry of Fuel and Power or the National Coal Board approached the Industry on the matter of a more rational manner of coal supplies they would be welcomed by an understanding technical body who would be only too anxious for mutual appreciation of each other's needs.

To base the selling price of coal on its calorific value might seem logical when considered in terms of heat release for steam raising and heat process work where, after initial combustion, the considerations were mainly physical. The carbonization of coal in the Gas Industry was a very different matter in so far as the process was largely chemical, and technical knowledge a valuable catalyst. The wide difference in the calorific content of coals was probably little understood by the majority of consumers and no doubt they would protest most strongly against variations arising from the direct linking of calorific value to selling price. The efficiency factor in its proposed form might also fail to justify its inclusion in the build-up of price and obviously, if that were to be put forward with all its variables, everybody would agree there would have to be a heavy scaling-down of the effect of the efficiency factor in the valuation formula. In a hand-fired installation it was probable that a very great proportion of the looked-for economy or justification of high cost of superior fuel would be translated into economy of physical effort and, apart from goodwill, a cash value might be hard to find.

Gas Industry's Requirements

Coming particularly to the requirements of the Gas Industry, Mr. Johnson said they had been stated quite clearly on various occasions—it required a regular supply of coals of consistent quality. Practically all undertakings were capable of laying down a reasonable stock against the demands and vagaries of winter transport, and usually the limitations on that were space considerations and, beyond a certain point, the need to provide expensive handling machinery beyond the resources of small undertakings. The excellent load factor of gas coals had always been a great boon to colliery salesmen and some credit might be given for that. It was by no wish of the Gas Industry that winter deliveries nowadays made such useful news headlines.

Consistency of coal quality was important and wide variations of ash content were considerably more embarrassing to the Gas Industry than the mean of the variations, had that been the consistent level of the deliveries. A similar remark applied to moisture. Ash and moisture content must be kept low and there was no reason why the total inerts need exceed 10% generally, with agreed departures for special grades. We need not be pedantic about the quality of individual coals where a sufficient number of sources of supply made mixing reasonably possible. Tolerances on individual coals could be arranged as between colliery and buyer and there was a lot to be said for the two parties mutually understanding each other's problems and agreeing reasonable tolerances which, in the main, should not react unfavourably upon the buyer and might easily be the means of assisting the colliery to produce particular grades of coal more cheaply than if it had to keep to unwavering analyses or sell short. That mutual understanding should go as far as acquaintance with the controllable factors which could influence the upper limits of ash and moisture content during preparation. There was nothing new in that; it had been done in the past and it could be done again.

Freedom of Choice

The Gas Industry must have reasonable freedom of choice, without being capricious, to select for its undertakings the coals best suited for the particular carbonizing processes and to select the most suitable grades of these coals. Since the inception of the coal selling schemes in 1936, and such other schemes as of necessity had followed them, the important matter of freedom of choice had been seriously curtailed. It might be that the smaller the customer the more easily his factor or supplier would accommodate his individual wishes, but there was a rigidity applying to the big consumers which left them no redress or means of tangible expression of approval or disapproval. The technical needs and requirements of undertakings rose above convenient commercial practices and the fact that the controllers of the coal trade did not care to admit that in the past was no reason why now, under a new regime, technical considerations should not assume their rightful place.

Whether the close contact now advocated between collieries and customers would produce coals of more consistent quality than in the immediate past would be a matter for goodwill. In Mr. Johnson's experience that co-operation had been most helpful. Bonus and penalty clauses had been touched upon, and he could quote from experience that where such an arrangement of price adjustment was mutually agreed it was found to work harmoniously both from the analytical and accountancy sides. It might be surprising to learn that collieries found that the operation of bonus and penalty clauses stimulated such a live interest in the appropriate departments of their business that quality automatically became so consistent over a period of years that it was possible to drop the arrangement by mutual consent and without prejudice to either party, at least up to the year 1940.

Coal Preparation

It was always physically possible, as Dr. Grumell and others had shown on various occasions, to prepare coals to a specification with reference to grading sizes, moisture, and ash, but, as Dr. Grumell had also shown, the cost and economics of working to specification were widely variable and the factors highly complex. At the present time there was an abundant supply of suitable gas coals mined to meet the requirements of the Gas Industry, but it might not be so readily appreciated that very substantial quantities of good gas coal, often carefully graded, were diverted to other industries, and in many cases to industries which would be no worse served by a different type of coal, thereby making the matter of supplies to the Gas Industry more exacting than need be the case to-day. When we looked at the wide variations in the cost of coal cleaning, the best interests of all concerned would be served by first giving gas coal to the Gas Industry, and, strangely enough, it was usually coals of that type which reacted most favourably to cleaning. There could be no justification under to-day's conditions for cleaning "difficult" coals to an acceptable standard at an uneconomic price and asking the Gas Industry to pay for it. Cost of coal cleaning, about which reliable data were but rarely revealed, was overdue for impartial examination to discover the least needs of the customer and the least cost at which they could be met. That would be a very different matter from the somewhat dubious economics attributed to some mining agents whose present practice was to raise the highest possible tonnage of stone and coal as a useful denominator in their alleged cost per ton of mining coal. It was no business of theirs that the unfortunate surface manager was expected to remove about three-quarters of the extraneous stone and refer to the cost of the operation as "loss of vend"! Loss of vend on what?

The Question of Valuation

It was to be expected that Dr. Grumell would emphatically agree that a calorific content formula such as he proposed could not apply to gas coals. The price variations envisaged by him were far too wide and price differentials between one coal and another, indeed between one grade and another, equivalent to the value of several therms of gas, hundredweights of coke, or gallons of tar and benzole, just could not be contemplated. It must be recognized that the number of individual undertakings capable of expressing a safe opinion on relative properties is strictly limited; therefore, great caution should be exercized in the expression of opinions. A range of typical coals had been examined for the purpose of helping forward the type of problem now under discussion and, broadly speaking, no relationship had been established between the yields of products of carbonization and any ascertainable properties of the original coal upon which values could be based. However, the search for a basis of valuation of relative properties must go on if it were felt that the existing price structure for gas coals was unacceptable. However, Mr. Johnson was of opinion that existing price differentials were not unfair.

It was repeatedly stated that the flat price increases of coals since 1939 were now such in cumulative effect as to destroy to a large extent the differentials as we originally knew them. It might not be generally known that over the same period the higher-priced coals had deteriorated to a greater extent than the cheaper ones. In the Northern coalfield there was a price differential of 1s. 3d. per ton as between the great bulk of gas coals and a selected few specials. Since 1939, in a series of representative tests aggregating a total consignment in excess of 10 million tons, the inert content of the special grade coal had also increased at the same flat rate as coals in the main category, *i.e.*, at a relatively higher rate. The decline in yield of gas therms was actually greater in the selected coals than in the main category, principally because of the inclusion of lower grade seams. On a pit price basis, therefore, the special grade coals were of lower relative worth than was the case in 1939; so that any suggestion that flat rate increases in price had reacted unfavourably against high quality coals should be re-examined, because such a contention would be challenged.

When that same problem was examined on a "delivered plus carbonized" basis the position was modified somewhat and in his examination, to maintain for the collieries the same global income, it seemed that the preponderating main class would need to be reduced in price by 1d. per ton and the special grades might justify an additional 2d. per ton. That was not to be interpreted as the special class being overdue for an increase of 3d. per ton and it should be made clear that such one-way interpretations, to which the coal trade had been addicted in the past, were not conducive to the free exchange of views by technical bodies.

Variable Value of Products

We could start by agreeing reasonably well the relative yields of gas therms from different coals; but difficulties immediately arose when to gas therms were added yields of tar or benzole and to a lesser degree yields or residual coke. It would be readily appreciated that the type of carbonizing plant, the temperature gradient and the time of carbonization, the effect of moisture and of "steaming" completely altered the respective product yields, and the value of products, therefore, was infinitely variable. Furthermore, the market value of each by-product had fluctuated between extremely wide limits in past years, and because of those unpredictable market values in the future it seemed almost impossible to include them as a considerable factor in fixing the value and selling price of coal. There was some prospect of bringing the problem under control if the examination of price were confined solely to the yield of straight gas therms, always remembering that the gas therm must be in acceptable form in terms of calorific value and specific gravity. In terms of therm content it was almost true that variations of gas yield from a particular coal changed inversely with variations in coke yield and tar or benzole yields according to the degree of "steaming" and "cracking" practised. That entailed acceptance of the principle that the varying yields of the respective by-product under varying conditions of carbonization approximately balanced out. That might sound specious to a degree, but it was seriously suggested that all considerations other than straight gas therm yield already mentioned were not worthy of the difficulties arising from them; and after examining the problem on that simplified basis it would seem that any general upheaval of prices of accepted gas coals could be avoided.

We had got to consider the position that arose from the insatiable demand for graded sizes, particularly singles and doubles. Dr. Grumell had said that that was now of the order of 50% of the Gas Industry's total requirement and it was a serious matter to contemplate. It was true that continuous vertical retorts worked exceedingly well on nut coals, but Mr. Johnson was not aware of any authority who had balanced the somewhat higher capital cost of continuous vertical retorts against the reduced operating, repair, and maintenance charges when carbonizing nut coals, and had expressed a credit in terms of pence-per-ton-of-coal premium price payable in justification of carbonizing nut coals.

On the other hand, it had been proved in recent years that continuous vertical retorts could carbonize successfully a far wider range of coals, particularly in terms of size, than many comfort-loving people were prepared to discover for themselves.

A careful examination of such data as were available seemed to indicate that the pre-war differential prices for nut grades were about correct. The present differentials would seem too high, but the gas engineer had a remedy in his own hands for that, and Dr. Grumell's proposals seemed very wide of the mark.

Prices and Politics

One thing to which we were fully alive was that any form of price structure must not be used for political ends. Something in the guise of a price structure must not be used to flog the Gas Industry for the benefit of electricity, nor must gas and electricity be flogged for the benefit of the coal industry. Already there might be the thought in many minds that efficient gas and electricity undertakings might be made to provide a substantial contribution towards the balancing of the very sad finances of the coal industry, which would be entirely wrong.

The introduction of a complete system of relative coal prices fully integrated for all industries, and for all consumers, to maintain balanced spheres of influence undisturbed between the respective fuels—other than to the extent to which they need be disturbed for the purpose of over-all economics—was desirable in itself, but was in fact almost impossible of achievement within a reasonable time.

It had been found necessary for him to touch upon coal marketing in its widest aspects to ensure that Dr. Grumell's excellent paper was viewed in relation to its true environment and not just in relation to existing coal prices. It was hoped that that manner of treatment would lead to an appreciation equally shared between the coal industry and the Gas Industry that there was very real need for panels from both sides to get together. It was not Mr. Johnson's view that there was any urgent need to throw up some complicated and tortuous price structure: but that we decide precisely what manner of treatment each coal should have to restore it to a more acceptable marketable state. and whether the cost of its improvement could justifiably be born by the consumer in return for a direct benefit. By such an examination we should then be able to classify coals according to ease of improvement, and their relative values thereafter would be more easily apparent to both parties.

Darlington Corporation has received sanction to borrow £17,500 for the purchase of gas meters and other appliances.

The Trade Statistics for August, 1947, just issued by the Department of Industry and Commerce in Eire, show imports of 11,362 tons of gas coal, valued at £32,357, as against 27,827 tons, valued at £82,007, in August, 1946. This brings the total of these imports for the first eight months of 1947 to 73,103 tons, valued at £253,431, compared with 171,298 tons valued at £499,570 in the corresponding period of 1946.

The First Monthly Meeting following the successful inauguration of the Gloucester Branch of the Women's Gas Council was given over to a demonstration on "Home Weaving," by Mrs. F. R. Capey, of the Gloucester School of Art. At the conclusion of the demonstration members were given the opportunity of working the looms which have been specially designed for use in the home. Mrs. C. B. Meehan, Chairman of the Inaugural Committee, is this year's Mayoress of the City of Gloucester, her husband, Councillor B. C. Meehan, having been elected to this high position following a term of office as the City High Sheriff.

"PUBLICITY PARADE"

It would, we think, be difficult to find within limited con pass a more vivid or a fresher exhibition than "Publicity Parade." Opened on Tuesday of last week at Gas Industry House this exhibition, depicting the services of the Publicity Division of the British Gas Council, is to continue till Dec. 31, and we are certain that, throughout its run, it will not diminish in its force of attraction. In a sense it is an exhibition by the expert for the expert, and as such does not fail. It is also a display of the art of publicity for all to see and to criticize—and by "all" we include individual gas undertakings throughout the land. The display is all the more welcome in that it comes at a time of general economic gloom and in that it shows a wholly commendable spirit of cheerfulness and courage in a period of flux (we are thinking more particularly of nationalization) in which the Gas Industry is not merely maintaining its load but is increasing its services in both home and industry. The merits of gas supply have been made known to the public, through publicity which has been the envy of many another industry, for many years. It is 36 years since gas undertakings banded together to develop one aspect of publicity on a national basis. The British Commercial Gas Association, in its many years of existence, countered apathy and criticism uncommonly well. With the funds at its disposal it accomplished a surprising volume of publicity work on an original basis and always on what we may rightly describe as a high plane ethically. Of course, some of its publicity campaigns were better than others; that applies to every form of continuous propaganda activity. For some time the B.C.G.A. has been merged in the British Gas Council, and publicity now is under a particular division of the Council. "Publicity Parade" affords striking evidence that the virility of gas advertising is by no means waning.

In most telling fashion this exhibition depicts the services of the Publicity Division and covers the comprehensive media used by the Council or offered to gas undertakings for local use. Editorial, education, exhibitions, films, information, lectures, photographs and posters, public relations and publications, radio and television—these are among the aspects covered. The object of this bright display is twofold. First, it is intended to interest those engaged in industry and commerce who are, or should be, using publicity. Secondly—and we regard this as none the less important—it is designed to focus the attention of those serving the Gas Industry on the need for sustained publicity and on the services and media available. The B.G.C. has produced a "Publicity Catalogue" giving details and prices of the numerous items of publicity material offered to members; and the Council is inviting many individuals and organizations outside the Industry to visit the exhibition during the period it is open. On the Monday preceding the opening, which was informal, there was a Press view which was largely attended, and on the same evening the General Manager of the B.G.C., Mr. J. R. W. Alexander "on the air" in the B.B.C. Home Service and other programmes following the six o'clock news, when a "Topical Talk" between Mr. Alexander and Mr. Douglas Willis, of the B.B.C., arising from the "Publicity Parade" exhibition, was given.

We may add that during the current year the British Gas Council has advertised in 24 national dailies and every Sunday newspaper, 67 leading provincial newspapers, 32 women's and other magazines, and 112 trade, technical, and professional journals. During the five weeks of last winter's fuel crisis, the Press Office dealt with over 2,000 Press enquiries. Over 6 million people attended recent national exhibitions at which there were Gas Industry displays.

In regard to films, 47 educational documentary films have been produced since 1935, and during the past 12 months the Council's films were shown to 4,500 selected audiences, including 2,000 schools.

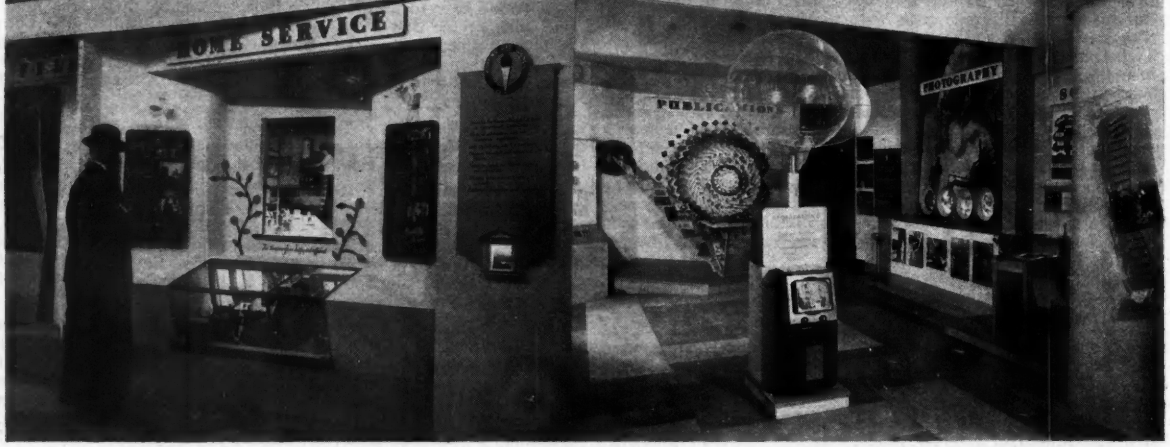
COIN COLLECTION AT LIVERPOOL

For some time, the Liverpool Gas Company has been experimenting to find the most efficient and economical means of transport for special coin collections.

The picture shows two Swallow Gadabouts which have just been put into service. These machines are new to English markets, and the Company says it is early yet to draw conclusions from their use. The men using them prefer the gadabouts because of their easier riding position and the lower centre of gravity. They say also, that they feel fresher at the end of the day's work.

Bolton Corporation is seeking authority to borrow £33,561 for the site of the new gas-works in Union Road and £16,361 for gas mains on housing estates.

Aberdeen Lighting Committee has recommended that lamplighters be provided with watches so that they can synchronize the setting of the mechanism in gas lamps. This will ensure that lamps go on at the same time all over the City. It was stated that at present one of the men carried an alarm clock. The subject is likely to provide something of a tussle in the Council Chamber. Provision of the cost of the watches—£55—is favoured by the Finance Committee, but only by a five to three majority.



Two sections of the "Publicity Parade" Exhibition at Gas Industry House. The exhibition, staged by the British Gas Council, depicts the Press and Publicity Services of the Gas Industry

BUILDING EXHIBITION, 1947

SINCE 1894, when it was first held in the Royal Agricultural Hall, the Building Exhibition appeared regularly every two years—that is, until the war. Since 1938 it has been one of the lamented losses to our list of events, and its re-appearance this year at Olympia, from Nov. 19, when it was opened by Mr. C. W. Key, M.P., Minister of Works, to Dec. 4, is particularly welcome. During its nine years of absence, building methods and materials have undergone a most drastic change; the introduction of pre-fabrication on a large scale; the use of waste material, such as woods shavings or straw, for manufacturing wall boards; the development of non-traditional materials, often as substitutes for those in short supply, including plastics and asbestos sheeting; the standardization of dimensions in houses, allowing the confident pre-fabrication of cupboards and structural components; and the improvement in insulation of walls and ceilings. All these innovations and developments, not to mention fluorescent lighting, improved appearance of many appliances, and startling changes in scaffolding and building methods, are to be readily observed at the exhibition.

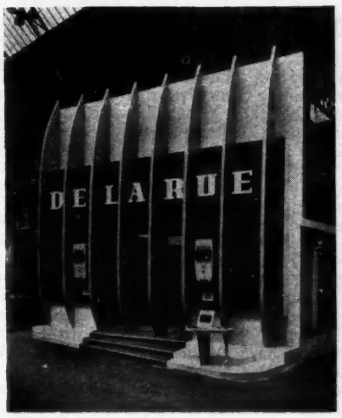
No less than five Government departments are exhibiting: The Ministry of Health shows types of post-war houses, demonstrating how they can fit into the landscape, and suggesting lines on which house planning for high density areas may evolve; the Ministry of Fuel shows various structural insulation and domestic heat services, including district heating; the Ministry of Labour and National Service (Factory Department) illustrates means for complying with the Regulations under the Factories Act, including examples and demonstrations of safety devices; the Ministry of Works and the Department of Scientific and Industrial Research indicate something of the work that has been done to increase the output of vital materials; and the other bodies represented include the R.I.B.A., the Architectural Association, the National Federation of Building Trades Employers, and the Council of Industrial Design. The last-named requires special mention for, in addition to presenting three full-sized rooms, furnished by three actual families, in collaboration with the Council's architect-designers, an exhibit is included showing the development of design in solid fuel stoves. This is both intriguing and amusing, each stove having a "period" surround and background; from the "Queen," of 1875, to the "Esse-Q" and "Diana" of to-day is indeed a long jump. Various types of modern domestic appliances burning smokeless fuels are also a feature of the Solid Smokeless Fuels Federation, and two convector open fires, one with back boiler and a chimney structure as fitted in a large number of the new L.C.C. houses and flats, a back-to-back cooker, a free-standing cooker, and a small domestic boiler with thermostatic control, are all shown in operation.

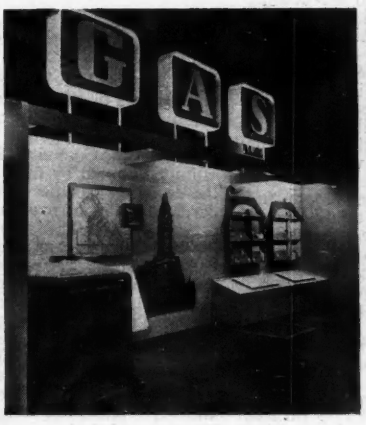
The Gas Industry is extremely well represented, for not only have the British Gas Council and several manufacturers of gas appliances impressive stands, gas-burning equipment appears on a number of otherwise unrelated exhibits. For example, the exhibit designed by Mrs. Davey Braddell and Lawrence Wright, A.R.I.B.A., to show how a back garden can be changed from a sordid muddle into a profitable and attractive space incorporates a gas-operated washing machine, sink heater, and drying cabinet.

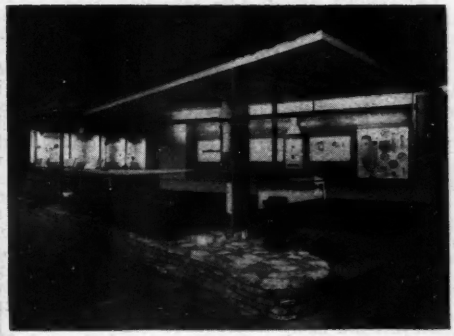
The cream and blue stand of the **British Gas Council** follows the elongated style to which one has become accustomed in recent months, a long rectangular platform with a smaller rectangular structure placed upon it. Dealing with cooking, water heating, space heating, home laundry, refrigeration, and all the domestic uses to which gas may be put, the stand exhibits numerous appliances. Of particular interest are the two relief models, showing a section through a house, and contrasting the old and the new methods of heating. Four types of flue for use with different types of gas fire and open gas-coke grates illustrate the necessity for a correct proportioning of heat and ventilation. Also heavily featured is a new prototype gas drying cupboard, exhibited by the Gas Light and Coke Company, which can be included in the construction of a new house, or an existing cupboard can be economically converted.

Trade Stands

The water heater manufacturers are all well represented, exhibiting a standard of design which competes favourably with that of most stands in the exhibition. For example, **De La Rue Gas Development, Ltd.**, have utilized the fluted design of their instantaneous multi-point water heater casing to produce a novel facade for their stand. In addition to this water heater, a neat gas cooker, a neat gas unit griller, a silent refrigerator, a Potterton Rex No. 1 type gas-fired boiler, and other appliances are shown.







Three examples of stand design at the Building Exhibition: left, the unusual frontal appearance of De La Rue Gas Development, Ltd.; centre, one aspect of the British Gas Council stand; right, chrysanthemums add to the attractiveness of the Ascot Gas Water Heaters, Ltd. exhibit.

Also attractive in appearance is the stand of **Ewart & Son, Ltd.**, which combines three water heaters (the M.210 multi-point geyser, the No. 30 bath geyser, and the M.75 sink geyser) with a selection of canteen equipment, including a "Snackmaster" with hot cupboard, an "Aquafont" café set, and a de-luxe "Trolleymaster."

Designed by Mr. Rodney Thomas, A.R.I.B.A., the **Ascot Gas Water Heaters, Ltd.**, stand ideally displays the different aspects of the Ascot service. There is, of course, the full range of instantaneous water heaters. In addition, a special display features the "Houses into Flats" theme, already well known in trade circles, and the Ascot Information Service to architects, local authorities, builders, &c., is illustrated by means of photographs, publications, and diagrams.

Both gas and electric appliances are featured by **Hurry Heaters, Ltd.**, with a stand displaying their wash boilers, washing machines, water heaters and housing equipment.

A considerable variety is to be seen on the stand of **Ranalah Sales Corporation, Ltd.**, for gas water heaters form only a part of the total exhibits. The heaters on show are the G.H.1 instantaneous and the G.H.2 large multi-point; Ranalah gas drying and airing cabinets are also shown, capable of drying a copperful of washing (some 14 lb.) in one hour at a cost of 1½d.

Electrolux, Ltd., exhibit two types of silent refrigerator, the M.151, designed to be built into kitchen fitments and obtainable at varying heights, and two new models, the L.M.150 (single unit) and L.M.150 (double unit), both of the table-top type with a raised edge, providing a working surface for the housewife. They are obtainable for use with gas, electricity, or oil.

Hoisting mechanism of many types is the speciality of **A. C. E. Machinery, Ltd.**, and winches and hoists for dealing with weights from 4 cwt. to 50 cwt. are exhibited on their stand. These include the Ace passenger/goods hoist and 30/50-cwt. winch, the House-builder "See-Saw" Mobilace hoist, the 15-cwt. concrete elevating plant, the 15-cwt. electrically-driven and 4-cwt. lightweight portable winch, and the 35 cwt. diesel-driven haulage and erecting winch.

M. B. Acheson, Ltd., exhibit Speedblocks for walls, partitions, floors, and roofs. Wall Speedblocks are vibrated hollow concrete blocks, equivalent in size to six bricks, rapid to lay and water-

and heat-resisting. Floor Speedblocks are similar, shaped to fit between concrete joists.

The well-known Muir-Hill equipment, manufactured by **E. Boydell & Co., Ltd.,** is typified on their stand by three of their new range of dumpers, all embodying the Muir-Hill patent revolving driver's seat and steering, giving two-way driving control. The models shown are 10B (2½ cu.yd.), 14B (3½ cu.yd), and 20B (5 cu.yd.).

Gas-fired steam boilers in sizes from 30,000 to 300,000 B.Th.U. per hour, riveted, and suitable for a maximum working pressure of 100 lb. per sq.in. gauge, are a notable product of **J. Brockhouse & Co., Ltd.,** as their stand indicates. Also shown are the "Selfstoke" gravity feed boiler and, actually working, the "Watts" boiler, a small model designed for service where the heat load ranges from 35,000 to 100,000 B.Th.U. hourly.

Experts in roof construction, the **Cementation Co., Ltd.,** show alternative forms of construction, using the Thermagrad system. Thermacoust wood wool slabs are used for suspended ceilings and internal skins of walls, these having a high degree of thermal insulation. Un-plastered slabs have a beneficial effect upon the acoustics of assembly halls, &c.

The uses to which copper tube may be put are legion, and the stand of the **Copper Development Association,** which illustrates many of the ways in which copper serves the building industry, includes water, gas, and sanitation. A special feature is the new British Standard (B.S. 1386-47) for "Copper Tubes to be Buried Underground."

The **Dunlop Rubber Co., Ltd.,** have concentrated on flooring and their stand illustrates the many ways in which this product may be used. Flooring for cinemas, theatres, business houses, ships, and hospitals are but a few of them.

Exhibits of two kinds are presented by **B. Finch & Co., Ltd.**—fireplace exhibits and sanitary exhibits. The former include working examples of the "Newer Heat" convector units, which have been widely demonstrated by the British Coal Utilization Joint Council and are now available for general distribution. The advantages are all night burning, ability to burn various fuels, background heating, &c.

The speciality of **George W. King, Ltd.,** is sliding doors and gear, and visitors to their stand are left in little doubt of the variety of their products; many of the examples shown are actually working. Particularly interesting is the King "Out-of-the-Way" and "Around-the-Corner" system, while the "Trantrac" gear for garage doors is also impressive. Designed for trolley-bus garages, it can be utilized whenever runways or conveyors are likely to prove an obstruction.

The well-known proofing products of **Grant & West, Ltd.,** are displayed to advantage on their attractive stand, together with a selection of pipe vices, spanners and wrenches, and similar tools. Familiar products exhibited include Cretex waterproofing compound, Revomer rust solvent, Belfo belt dressing, Eagle furnace cement, Flinso tinning compound, Riscor wood block emulsion and black varnish.

A complete range of water heating units and steam boilers graces the stand of **Halliday Boilers, Ltd.** The combination boiler combines the advantages of the circulating boiler, the standard domestic unit, with a self-contained storage tank where greater quantities of water are required; the domestic unit is built up into batteries of from one to five. Also shown are the "B" type boiler for combining central heating and domestic supply (output 150,000 B.Th.U. per hour), and the Halliday steam boiler with gas or oil firing (evaporation 100 lb. per hour).

G. A. Harvey & Co. (London), Ltd., exhibit an astonishing selection of metal products: zinc and copper roofing; ventilators, chimneys, and cowls; galvanized tanks, calorifiers, and indirect cylinders; wirework and perforated metals of every description for window guards, radiator and pipe covers, and machinery guards; woven wire gauge in all meshes for screening requirements; mild steel crimped and hot shrunk "Tapergil" gilled tubes for heating, cooking and drying; sheet metal and steel platework for industrial plant; and office and works steel furniture.

Demonstrations of pointing methods for lead and lead alloy pipe, and leadburning as applied to lead sheet and pipe are a feature of the interesting stand of the **Lead Industries Development Council.** Also of interest is a full-scale example of duct plumbing, similar in design to that used by the L.C.C. for a new block of flats. Display panels give information on British Standards for lead and lead alloy pipe and similar materials.

Full circle slewing, with dual roller path, diesel power unit, two-speed travel both forward and reverse, instantaneously reversible, free-wheel, differential drive, and patent safety hoist unit are some of the outstanding features of the Neal type "NM" mobile crane (2-ton capacity) exhibited by **R. H. Neal & Co., Ltd.** Other cranes shown are the "G" portable petrol type (15-cwt. capacity) and the "AM" portable petrol type (8-cwt. capacity). These are not self-propelling, but may be easily towed from place to place, or transported by the average lorry. Also exhibited is the Winget/Neal 10/7 "Rapid" rotary closed drum concrete mixer.

Three types of concrete mixer form the principal source of interest on the stand of **Frederick Parker, Ltd.** These are the "Little Giant" hand-fed type, models 3½ GT and 3½ G (5/3½ cu.ft.) and 5 G (7/5 cu.ft.); the "Speedia" roller-bearing, loader-fed type, of which models 7 D (10/7 cu.ft.) and 5 D (7/5 cu.ft.) are shown; and "Non-Tilt" loader fed type, represented by Model 7 S (10/7 cu.ft.). Parker "Hoistex" equipment and the "Monarch" light stone-crusher, represented by a 10 in. by 7 in. model, capable of an approximate output of 4/5 tons per hour.

Road mending equipment of many types is exhibited by **Pegson, Ltd.,** including a power rammer, road ripper, counter-current concrete mixer, and various types of crusher. The stand also displays the Pegson-Marlow pumps, portable or stationary, with outputs from 3,000 to 200,000 gall. an hour, and the "Mud-Hog" pumps for handling ooze and heavy wastes.

The products of the **Rawlplug Co., Ltd.,** are too well known to need description, and demonstration units of many of their devices are shown on their stand. Apart from the many variations on the Rawlplug principle, the original Rawlplug is tested by representatives to prove that these devices can take a strain a million times its own weight.

Roneo, Ltd., have two stands at the exhibition, one showing steel partitions for dividing up office space, and the other a machine for reproducing estimates, letterheads, &c. The 45 RB partitions possess such advantages as extreme strength, fire-resistance, flush panelling, and numerous colour schemes, while within them may be hidden all wires and similar appendages. Roneo type E partitions are intended for factory use.

IMPERIAL COLLEGE VACATION WORK

The 13th annual report on the vacation work scheme for students of the Imperial College of Science and Technology records that increasing numbers of students are availing themselves of the scheme which is proved by the number of registrations to have become an accepted adjunct to the theoretical and practical training provided within the College. The Committee feels that this is due largely to the progressive attitude adopted by firms which have been kind enough to provide the necessary facilities for vacation work and the more or less standardized scales of payment and hours of work.

New features have developed rapidly during the year. In 1946 an international exchange system was arranged, whereby Imperial College students visited firms abroad while an equivalent number of students from abroad were accommodated by firms in this country. For the first year 46 students in all took part; this year the number ncreased to 221 (105 going abroad and 116 visiting this country) and 125 firms took part in the venture (70 abroad and 55 British). The reports of the returning students have justified the Committee in its belief in the educational value of the scheme.

Only those who have already engaged in vacation work at home are allowed to undertake such work abroad unless they are ex-servicemen. The Imperial College students have been so impressed with the hospitality they have received in other countries (Belgium, Czechoslovakia, Denmark, Finland, France, Holland, Norway, Sweden, and Switzerland) that they have taken special steps to arrange for the reception, hospitality, and entertainment of the incoming students.

Industrial tours initiated last year have been continued this year with growing success. Groups of staff and students paid visits to Holland (28) and to Sweden (79) on extended studies of industrial concerns, and so obtained a survey of the industrial structure of these countries. The Committee expresses gratitude for the kindness and hospitality received everywhere during these visits. Two students went to Canada and two on oil tankers to Persia.

The Parade, Leamington, is at present being used for lighting experiments, part being taken over by the Leamington Priors Gas Company for displaying improved methods, and another stretch devoted to fluorescent lighting.

Wallets of Notes have been presented by the Chairman of the Walsall Corporation Gas Committee to eight employees of the Gas Department who have retired during the past year. They were Messrs. F. Breedon H. Drury, I. Griffiths, J. Steed, J. W. Lymall, J. Harrison, W. Beard and J. Ryson.

Accrington District Gas and Water Board reports a net surplus on the gas undertaking of £10,232 against £197 last year. Out of a total revenue income of £157,817, £39,319 was required for interest and sinking fund, tax, district rates, war damage, and making-up Service pay. Copper handled during the year weighed 250 tons. Total cost of distribution was £19,365, an increase of £5,541, and net capital indebtedness on Mar. 31 was £101,741.

Mr. Harold Platt, Engineer and Manager of the Bolton Gas Department, states that unless considerable economies are made drastic cuts will be necessary in the pressure. He has told his committee that the Ministry of Fuel and Power was unable to allocate steel to the gas undertaking for distribution purposes. This would mean a curtailment of all services, including street lighting. Twelve retorts which had been repaired were now back in operation but the demand had been so great that it had been impossible to shut down the water gas plant for repairs. Pressure had already been reduced slightly.

GAS STOCKS AND SHARES

There was a substantial rise in the number of dealings on the Stock Exchange last week; in fact the total for the Monday was the highest since the Tuesday following August Bank Holiday. Opening on a cautious note in view of the opening of the Foreign Ministers' Conference and the crisis in France, markets became firmer during the week. A sharp break in British Funds was followed by a marked recovery, and there were widespread gains in industrial shares.

Gas stock transactions for the week ended Thursday totalled 259 against 197 for the previous week. Slight gains early in the week in Gas Light and Coke Ordinary were maintained, and there was a rise of 6d. in Primitiva Holdings on the strength of the favourable news concerning the embargo case of the Primitiva Gas Company of Buenos Aires. In last month's stock table the Plymouth and Stonehouse Gas Company's £10 Additional shares were quoted in error at 12s. 6d.-14s. 6d. and the £10 New shares at 12s.-14s. The figures should be £12 10s.-£14 10s. and £12-£14 respectively.

Rises and falls recorded last week were as follows.

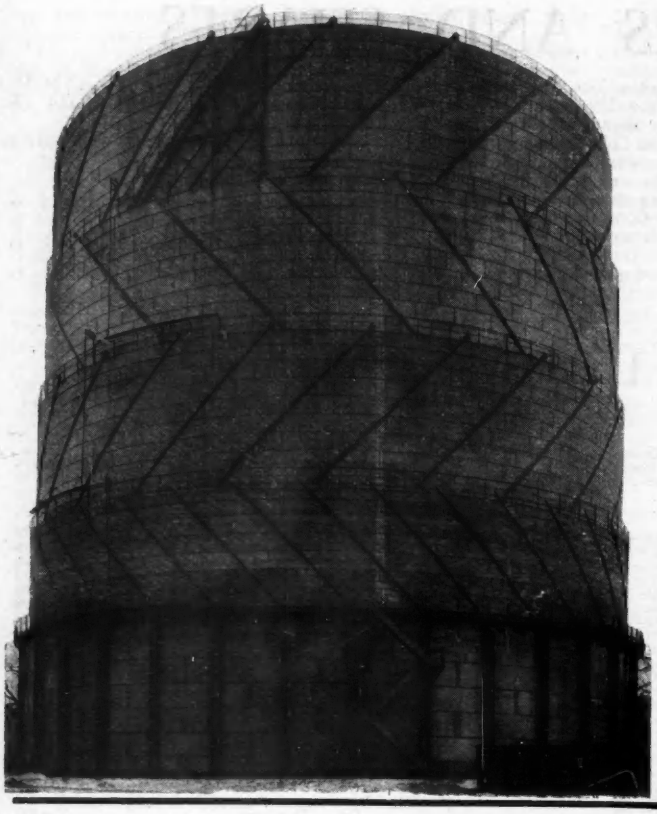
OFFICIAL LIST

Gas Light & Coke, ord. ...	20/9 — 21/9	+	3d.
Imperial Continental, cap. ...	107 — 112	—	1
Newport, (Mon.) cons. ...	97 — 102	—	3
Primitiva Holdings, ord. ...	11/ — 13/	+	6d.
Wandsworth, cons. ...	98 — 103	+	1
Watford & St. Albans, 5½ p.c. pref.	108 — 113	—	2

Quotations on the London Stock Exchange

When last ex-Dividend	Dividends Interest.% Last Yr.	Prev. Yr.	NAME.	Quotations Nov. 27
Sept. 3	—	4	Alliance & Dublin Cons. Ord.	20/6—22/6
Oct. 29	5	5	Asscd. Gas & Water U'd'tgs Ord.	18/ —20/
,,	6	6	Do. Deferred	18/ —20/
Sept. 3	4½	4½	Do. 4½ p.c. Red. Cum. Pref.... ...	19/ —21/
,,	4	4	Do. 4 p.c. Red. Cum. Pref.	18/6—20/6
,,	4	4	Do. 4 p.c. Irred. Cum. Pref.... ...	18/6—20/6
Aug. 20	—	7	Barnet Ord. 7 p.c. max.	140—150
Aug 6	—	5	Bath Cons. Ord .5 p.c. basic	97—102
Sept. 17	6½	10	Bombay, Ltd., Stock	46/- -49/-
Sept. 3	—	8½	Bournemouth Std. 5 p.c. sliding scale ...	165—175
,,	7	7	Do. 7 p.c. max. div.	142—152
,,	4	4	Do. 4 p.c. Pref.	97—102
,,	6	6	Do. 6 p.c. Pref.	124—129
Sept. 3	3½	3½	Do. 3½ p.c. Red. Deb.	95—100
June 4	4	4	Do. Perp. 4 p.c. Deb.	97—102
Aug. 20	—	5·35	Brighton, &c., 5 p.c. Std. Cons.	95—100
,,	—	6·3	Do. 6 p.c. Std. Cons.	107—112
June 4	5	5	Do. 5 p.c. Perp. Deb.	110—115
Aug. 6	—	5	Bristol, Gen. Cap. 5 p.c. max.	97—102
June 4	...	4	Do. 4 p.c. New Deb. Red.	95—100
Oct. 1	—	7½	Brit. Gas Light Ord.	117—122
June 18	...	5½	Do. 5½ p.c. 'B' Cum. Pref.	107—112
June 4	4	4	Do. 4 p.c. Red. Deb.	95—100
Aug. 6	—	10	Cambridge U. & T. Orig. 10 p.c. Cons. ...	180—190
,,	—	5	Do. 5 p.c. Cons. 'C'	95—100
,,	—	7	Do. 7 p.c. Cons. 'B.'	125—130
Oct. 15	4½	4½	Cape Town, Ltd., 4½ p.c. Cu. Pf.	15/6—17/6
July 16	—	6½	Cardiff Con. Ord.	113—118
Aug. 6	—	5	Cheltenham, 5 p.c. basic Cons. Ord. ...	97—102
June 18	4	4	Do. 4 p.c. Perp. Deb.	95—100
Aug. 6	—	5¾	Chester Unked Ord.	105—110
Oct. 29	—	7	Colombo Ltd., Ord.	35/ —40/
,,	—	7	Do. 7 p.c. Pref.	23/6—25/6
Oct. 15	5	5	Colonial Gas Assn. Ltd. Ord.	16/—18/-
,,	—	8	Do. 8 p.c. Pref....	24/—26/-
Aug. 6	—	5	Commercial Ord.	78— 83
June 4	...	3	Do. 3 p.c. Deb. Perp.	78— 83
Aug. 20	5	5	Do. 5 p.c. Irred. Deb....	108—113
,,	—	6	Croydon sliding scale	113—118
,,	—	5	Do. max. div.	95—100
,,	4	4	Do. 4 p.c. Irred. Pref.	92— 97
June 18	4	4	Do. 4 p.c. Perp. Deb....	97—102
,,	5	5	Do. 5 p.c. Perp. Deb....	110—115
Aug. 20	—	8½	Derby Cons. Ord.	138—143
June 18	4	4	Do. 4 p.c. Red. Deb.	95—100
Aug. 6	—	5	East Hull Ord.	92— 97
Aug. 20	—	5	East Surrey 'B,' 5 p.c	97—102
,,	—	6	Do. 6 p.c. Cum. Pref....	112—117
June 18	5	5	Do. 5 p.c. Irred. Deb.	110—115
Feb. 26	6¾	6¾	East Wight Cons. Ord.	110—120
Aug. 6	—	5	Eastbourne 'A'	90—100
,,	—	3½	Do. 'B'	85— 95
Nov. 12	5	5	Gas Consolidation Ord. 'A'	18/6—20/6
,,	5	5	Do. Ord. 'B'	18/6—20/6
,,	4	4	Do. 4 p.c. Red. Cum. Pref.	18/6—20/6
Aug. 6	—	5	Gas Light & Coke Ord.	20/9—21/9
,,	—	3½	Do. 3½ p.c. max.	77— 82
,,	—	4	Do. 4 p.c. Con. Pref.	97—102
July 2	3¾	3¾	Do. 3¾ p.c. Red. Pref.... ...	94— 99
Nov. 26	3	3	Do. 3 p.c. Con. Deb.	85— 90xd
,,	5	5	Do. 5 p.c. Deb.	101—106xd
,,	4½	4½	Do. 4½ p.c. Red. Deb.	102—107xd
Sept. 3	3½	3½	Do. 3½ p.c. Red. Deb....	92— 97
Aug. 6	—	5	Gloucester Cons. Ord.	97—102
Feb. 12	2	Nil	Great Yarmouth (8½ p.c. max)	10 12½
Sept. 3	—	7½	Guildford Cons. Ord.	128—138
Aug. 20	—	5	Hampton C't, 5 p.c. Cons. Ord.	95—100
Sept. 3	—	5	Hartlepool G. & W. 5 p.c. Ord.	97—102
Oct. 1	—	6	Hastings & St. L. (5 p.c. Std.)	103—108
,,	—	5	Do. (3½ p.c. Std.)	87— 92
June 18	7½	6	Holyhead & N. Wales Ord.	22/—24/-
Aug. 6	—	5	Hornsey 3½ p.c. Std.	93— 98
,,	—	6·7/8	Do. 5 p.c. Std	115—120
May 14	8½	8	Imperial Continental Cap.	107—112
July 16	—	3½	Do. 3½ p.c. Red. Deb....	95—100
Aug. 20	—	7½	Lea Bridge Co., Cons. Ord....	125—135
Aug. 6	—	5½	Liverpool 5 p.c. Ord.	107—112
Sept. 17	—	7½	Luton Cons. Ord. 'A'	120—130
,,	—	6¼	Do. Ord. 'B'	105—115

When last ex-Dividend	Dividends Interest.% Last Yr.	Pref. Yr.	NAME.	Quotations Nov. 27
July 16	7	7	Malta & Med'n., 7 p.c. 1st Pref.	100—110
,,	—	7½	Do. 7½ p.c. 2nd. Pref....	105—115
Aug. 20	—	5 5/6	M.S. Utility 'A' Cons.	97—102
		3 3/20	Do. 'B' Cons.	68— 73
		—	Do. 'C' Cons.	95—100
		5	Do. 4 p.c. Cons. Pref.	93— 98
		4	Montevideo, Ltd. Ord.	112—122
Oct. 29	4	4	Newcastle and Gateshead Ord.	22/—24/-
Aug. 6	—	5⅝	Do. 3½ p.c. Perp. Deb.	90— 95
July 2	3½	3½	Newport (Mon.) Cons.	97—102
,,	—	7	Do. 5 p.c. Perp. Deb....	108—112
June 18	5	5	North Middlesex 6 p.c.	115—120
Aug. 6	—	6⅜	Do. 5 p.c. Pref.	103—108
,,		5	Northampton Cons.	99 —104
,,		5	Oxford, Cons. Ord.	160—180
,,		—	Plymouth & Stone Ord.	103—108
June 18	5⅝	10	Do. Addl.	12½— 14½
,,	8½	5⅝	Do. New	12 — 14
,,	7½	8½	Do. 5 p.c. Deb. Perp....	110—115
Sept. 17	5	7½	Portsmouth & Gosport Cons.	132—137
,,		—	Do. 5 p.c. max.	95—100
Aug. 6	—	5	Preston 'A'	170—190
,,	—	10	Do. 'B'	130—135
June 24	46	7	Primitiva Holdings, Ltd. Ord.	11/—13/-
June 4	...	2	Do. 6½ p.c. Red. Cum. Pref.	99—104
June 18	4	6	Reading, 5 p.c. max.	97—102
,,	—	5	Do. 4 p.c. Perp. Deb....	95—100
Sept. 30	4	—	Do. 3½ p.c. Red. (Non-Cum.) Pref....	95—100
Sept. 17	—	4	Romford, Ord.	97—102
,,	4½	7½	Do. 4 p.c. Debs. Red....	95—100
,,	—	4½	Severn Val. Ltd. Ord.	21/—23/-
Aug. 20	—	6½	Do. 4½ p.c. Cum. Pref.	19/6—21/6
June 16	4	4	Sheffield Cons....	123—128
Sept. 3	—	6	Do. 4 p.c. Red. Deb.	98—103
,,	—	4½	South East'n Gas Ltd. Ord.	20/—22/-
,,	—	4	Do. 4½ p.c. Red. Cum. Pref.	19-/—21/-
,,	—	4	Do. 4 p.c. Irred. Cum. Pref.	18/—20/-
Aug. 6	—	5	South Metropolitan Ord.	85 — 89
,,	6	6	Do. 6 p.c. Irred. Pref....	113 —118
,,	4	4	Do. 4 p.c. Irred. Pref.	93 — 98
June 18	3	3	Do. 3 p.c. Perp. Deb.	82 — 87
July 16	5	5	Do. 5 p.c. Red. Deb.	97 —102
Aug. 6	—	5	South Suburban Ord. 5 p.c.	97 —102
,,	5	5	Do. 5 p.c. Perp. Pref....	103 —108
,,	4	4	Do. 4 p.c. Perp. Pref....	95 —100
,,	3¾	3¾	Do. 3¾ p.c. Red. Pref....	95 —100
,,	5	5	Do. 5 p.c. Perp. Deb....	110 —115
,,	—	5½	South West. G. & W. Ltd. Ord.	19/—21/-
,,	—	5	Southampton Ord.	97 —102
,,	—	6	Sunderland Ord.	118 —123
,,	—	4½	Swansea Ord.	82 — 87
,,	5½	5½	Do. 5½ p.c. Red. Pref.	97 —102
Sept. 17	—	7	Swindon Cons. Ord.	113 —118
Aug. 6	—	5	Tottenham Ord.	97 —102
,,	—	5	Do. 5 p.c. Pref.	103 —108
,,	—	5½	Do. 5½ p.c. Irred. Pref.	110 —115
,,	4	4	Do. 4 p.c. Perp. Deb....	95 —100
June 4	4	4	Tunbridge Wells, 4 p.c. Sliding	115 —120
Oct. 1	—	7½	U. Kingdom Ltd. Ord.	20/6—22/6
Nov. 12	—	6	Do. 4½ p.c. 1st Cum. Pref.	20/—22/-
,,	4½	4½	Do. 4 p.c. 1st Red. Cum. Pref.... ...	19/—21/-
,,	4	4	Do. 4½ p.c. 2nd Non. Cum. Pf.... ...	19/—21/-
June 18	4½	4½	Do. 3½ p.c. Red. Deb....	95 —100
Sept. 17	3½	3½	Uxbridge, &c., 5 p.c. Cap.	120 —125
Aug. 6	—	6⅝	Do. 5 p.c. Pref.	103 —108
,,	5	5	Do. 5 p.c. Perp. Deb.	110 —115xd
Nov. 26	5	5	Wandsworth Cons.	98 —103
Aug. 6	—	5	Do. 4 p.c. Pref....	93 — 98
,,	4	4	Do. 5 p.c. Irred. Deb....	110 —115
June 18	5	5	Do. 4 p.c. Irred. Deb....	95 —100
,,	4	4	Watford & St. Albans Ord.	97 —102
Aug. 6	—	5	Do. 5 p.c. Pref.	103 —108
,,	5	5½	Do. 5½ p.c. Pref.	108 —113
,,	—	5	Weymouth Ord. (5 p.c. Basic)	95 —100
,,	—	11	Woking District "A" Ord....	180 —190
,,	—	7·7	Do. "B" Ord....	130 —135
Aug. 20	—	8	Wolverhampton Cons. Ord.	118 —123
Sept. 3	—	5	York Cons. Ord.	87 — 92



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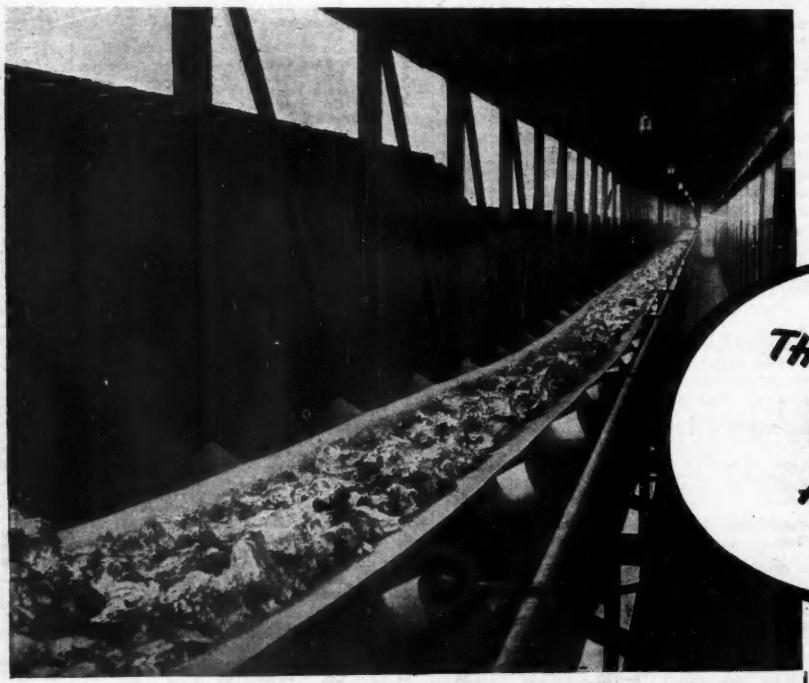

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PUBLICATIONS RECEIVED

The varied municipal activities which provide Birmingham's million citizens with homes, educational, and health services, with water, gas, and electricity, with transport services, with municipal meals and with even municipal banking, and many other services besides are fully described in the *City of Birmingham Handbook* which has just been issued by the City's Information Department, price 2s. 6d., or 3s. post free. The Handbook, which is compiled and edited by Birmingham's Public Relations Officer, serves a double purpose. It will enlighten many citizens as to the multifarious activities of their City Council and it will illustrate to the world the extent to which Birmingham has developed from an obscure hamlet on the banks of the River Rea to the proud position of England's second city. An interesting first chapter traces the history of Birmingham from the time of the Doomsday Book when "it was and is worth 20 shillings" (in contrast to a rateable value to-day of over £7,000,000) and this section includes a picturesque, though probably not unbiassed account of the Battle of Birmingham during the Civil War when the town had "as great fame for hearty, wilful, affected disloyalty to the King as any place in England." An "Introduction to Civic Management" traces briefly the modern municipality's interest in its citizens from the ante-natal clinic to the municipal cemetery, and subsequent chapters give a fascinating story of the civic administration of Birmingham to-day.

Many plans for a new Birmingham, which will be proceeded with when circumstances permit, are described within the 208 well illustrated pages of the Handbook, including an inner ring road which at an estimated cost of £15,000,000 will revolutionize traffic in the City centre; an old people's home which includes bed-sitting rooms furnished with easy chairs, built-in wardrobes and lavatory basins; a new reservoir in the Elan Valley, four miles long, for the Water Department involving the construction of a dam 182 ft. high to impound over 10,000 million gall. of water; a new six-storey civic restaurant building, and a vast new central market covering an area of nearly 6,000 sq. yds. The Handbook should provide a valuable contribution to the Public Relation's activities which are being carried out by the Birmingham City Council and will answer the enquiry of many citizens as to "where the rates go."

GAS PRODUCTS PRICES

The London Market

November 29

There are no changes to report in the prices of coal tar products.

Scotland

November 29

Average prices for gas-works products this week are: Pitch, 75s. per ton; toluole, naked, North, 90's, 2s. 4d. to 2s. 6¾d. per gall.; pure, 3s. 2¼d. Prices for carbolic acid 60's anthracene, creosote oil (hydrogenation), coal tar oils (timber preservation, &c.) and strained anthracene oil are controlled by Government Orders Prices for road tar are increased by one penny per gall. by S. R. & O. 1947, 177.

The Provinces

November 29

Home prices are still unchanged but new schedules are anticipated in the near future.

Refined tar.* Yield to the distiller is 6d. per gall. ex works, naked. Creosote oil. Timber preserving quality* 5¼d. to 6¼d. per gall.; hydrogenation oil* 5¾d. per gall.; low gravity or virgin oil† 7¼d. to 7½d. per gall.; benzol absorbing oil 6¼d. to 8d. per gall. Refined cresylic acid is 3s. 6d. to 4s. 6d. per gall. ex works, naked, according to quality. Crude naphtha† 8d. to 10d. per gall. Solvent naphtha.* Basic maximum prices delivered in bulk 90/160 grade 2s. 10d. per gall., and 90/190 heavy naphtha, unrectified, 2s. 0½d. per gall.; rectified, 2s. 4d. per gall. Pyridine,† 90/160 grade 15s. per gall., and 90/140 grade 17s. per gall.

* Price controlled. † Uncontrolled.

In keeping with their service policy Bratt Colbran, Ltd., are issuing instruction folders with all their post-war appliances, which, in addition to the necessary fitters' adjustment instructions, embody technical maintenance data, &c., and are intended for the use of salesmen, foremen, and fitters, by whom it is hoped they will be retained for reference purposes. Already such folders have been issued covering the firm's Luminous Panel heater and Neat "Lancelot" fire. Others are in course of preparation. To keep this literature up to date, modification slips will be issued from time to time should any slight modification or alteration to the appliance be found to be desirable. Copies of these sales technical folders may be obtained on application.

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